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ELECTRICAL WORLD

FEBRUARY 22, 1930

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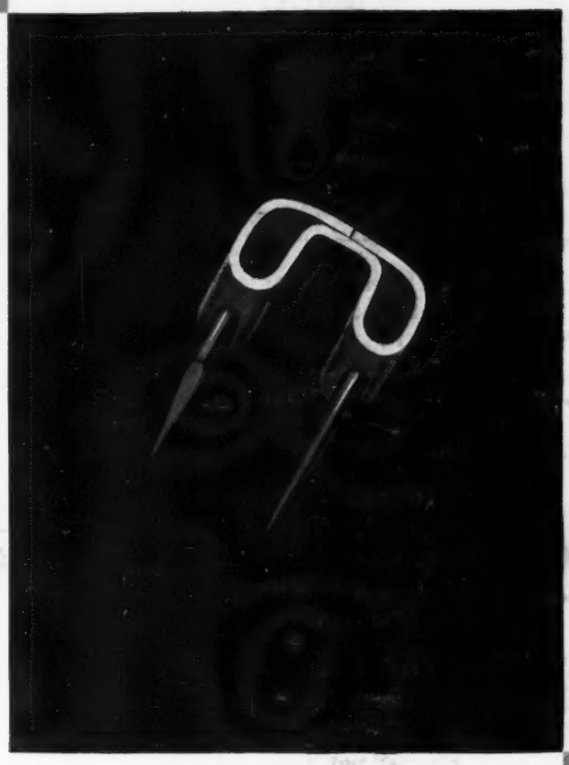

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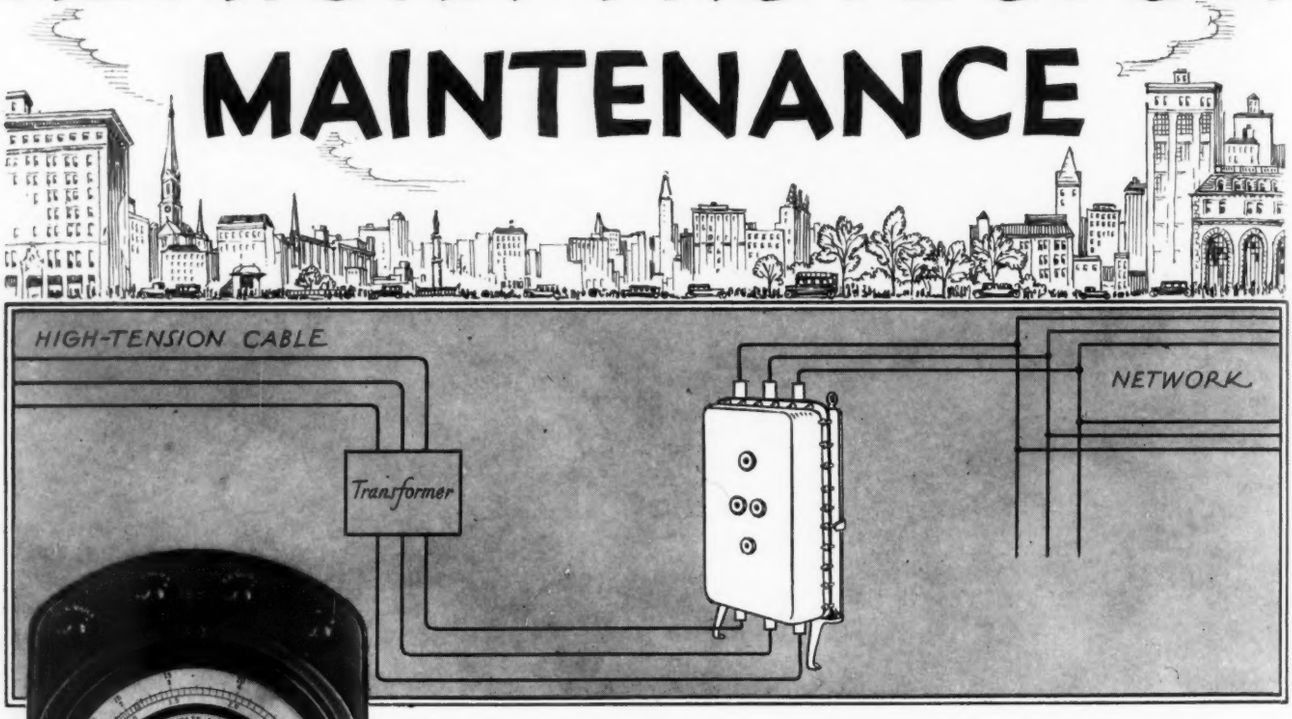

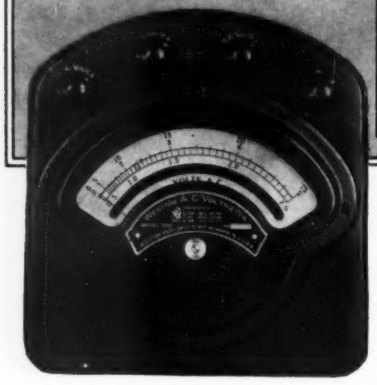

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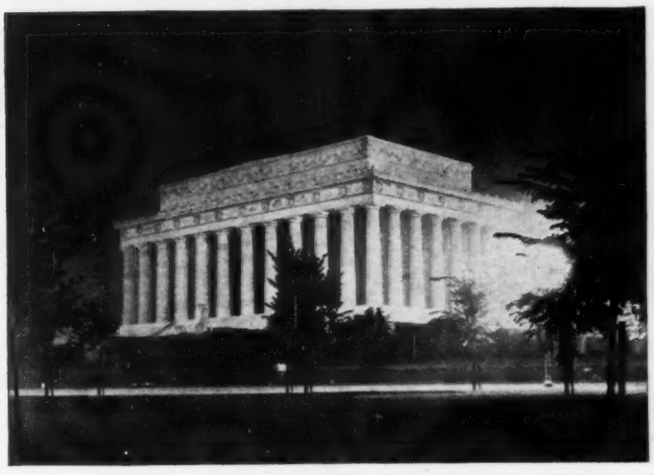

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ELECTRICAL WORLD

for the Week Ending

February 22, 1930

Comment On the News

THE NEW REGULATORY BODY proposed by Senator Couzens to supervise communications is opposed in a progress report of the American Engineering Council. As the A.E.C. reports, there is greater need of reorganizing existing governmental agencies than there is of creating new ones.

CALLED IN TO MAKE a thorough check of accounts of the Seattle municipal electric system, a firm of expert accountants has reported an astonishingly high percentage of past-due or delinquent accounts and expressed severe criticism of inefficient methods. Believers in private ownership have long held that such conditions are almost inevitable when a municipality departs from governmental functions and enters the legitimate field of private enterprise.

THE PERSISTENT DISPUTE over prelicense valuations between the secretary of the Federal Power Commission on the one side and its solicitor and chief accountant on the other is now being aired before the Senate's committee on interstate commerce. The public's interest, as well as the utilities', seems to lie largely in the relation of present valuation to recapture price fifty years hence. Will the principle at stake have immediate import by becoming a factor in fixing rates?

DELVING IN THE EARTH is one of the most ancient of human pursuits, but a large substation built on bedrock a hundred feet below a teeming business district in the metropolis of the United States is something new. The substation in question has been put into service by the New York Central Railroad and is a splendid example of difficulties overcome in the cause of electrification.

NO FURTHER DANGER is believed to exist of the passing of control of the Hartford Electric Light Company into outside hands. The directors have recommended the abolition of the present stockholders' voting trust in view of the change in market conditions. The price differential between so-called "free" and deposited shares has proved a handicap to holders of this security. Will this movement spread to other companies or will the voting-trust policy be preserved as a corral for lively securities?

NEWS OF THE WEEK

Russell-Bonner Controversy Occupies Senator Couzens' Committee

A VIGOROUS protest against the contemplated strangling of power company initiative by government red tape was made by F. E. Bonner, executive secretary of the Federal Power Commission, who appeared on Thursday of this week before the Senate committee on interstate commerce. In reply to personal attacks made upon him at hearings earlier in the week Mr. Bonner declared that his position had been entirely misrepresented and that his intention was obviously to further rather than to defeat the purposes of the water-power act. The commission's primary object, he pointed out, is to allow power developments to proceed rapidly to meet the growing need for household and industrial energy. To block these projects for a detailed accounting down to the last penny, he asserted, would be an economic crime. The bookkeeping, he contended, can come later without damaging the public interest in the slightest degree.

Nobody has received favors or made steals under federal licensing of power projects, Mr. Bonner declared. No licenses have been rushed through without a thorough study of the legal rights involved. No case has been denied a fair hearing. The commission's rulings, the secretary continued, have not cost the public one cent through the rate structure, on which he holds they have no effect, and have in no way jeopardized the control of public properties.

Federal licenses so far issued have sought to allow industry its normal expansion without artificial obstacles. It is unthinkable, said Mr. Bonner, that a legitimate project should be delayed perhaps for years awaiting the adjustment of detailed accounting which has no effect on anybody's rights except as concerns a possible recapture or transfer fifty years hence. It was admitted that some items of net investment on the power companies' books might be disallowed by later action of the commission or the courts. Mr. Bonner said that he has been working toward a solution of this problem. Having been appointed only a few months ago, he does not propose to be pushed into a premature commitment.

The committee hearings are in connection with a bill introduced by Senator Couzens on Tuesday to remove the Federal Power Commission from the control of the Secretaries of War, the Interior and Agriculture and to appoint three full-time men for six-year terms at $10,000 a year. The hearings are expected to lead into holding-company matters, but they will not overlap, though they will probably expand, the Federal Trade Commission's investigation of utility finance. The latter starts next Monday, February 24, the hearing set for February 18 having been postposed until then.

As first witness in the probe, Charles A. Russell, the commission's solicitor, appeared on Tuesday, February 18. Mr. Russell scathingly criticised the policies of Mr. Bonner, particularly as regards valuation and accounting methods, and attacked a few power companies for good measure.

Solicitor Russell's examination opened with the question why certain documents relating to the Flathead (Mont.) project were withheld from the committee on the ground that their publication was "against the public policy." Flathead has been a sensational topic because of charges involving the debauchery of Indians by firewater and other persuasive measures. Some of the Senators and the newspapers felt that something was being concealed. The answer was simply that the broadcasting of interoffice notes on a pending decision, just as in a court case, would throw the de-

—*Wide World Photos.*

EDISON AND HIS TWO FRIENDS

Henry Ford and Harvey Firestone were with Mr. and Mrs. Edison when the plaque in the inventor's honor was unveiled at Fort Myers, Fla., his winter home, last week.

liberation open to outside influence and otherwise obstruct action. The basic data underlying a decision are, of course, matters of public record.

The main point of controversy is over valuation and general accounting methods. W. V. King, commission accountant, wants to set up an organization which will keep a meticulous record of all historic costs of a licensed project. Mr. Russell sides with him.

After Mr. Russell was appointed as solicitor seven months ago and had accepted Mr. King's accounting philosophy, he says he was approached by representatives of power interests at the instance of Mr. Bonner. In a conference with M. O. Leighton, a consulting engineer said to represent the Electric Bond & Share Company, he was informed that Mr. King counted the bricks in a building and made dollar deductions on window-curtain items. Mr. Russell said in effect: "Leighton told me how to run my job and to 'lay off' the power people."

The witness further said that Mr. Bonner "undertakes to settle questions of engineering and accounting of which he doesn't know anything at all," thus usurping the powers of the Secretary-commissioners.

Valuation of the Niagara Power Company was displayed in considerable detail as evidence of faulty functioning on the part of the commission. Russell said that the value now on the books includes $30,000,000 for the "water the government gives them." He mentioned an item of $140,000 written into the value of three Byllesby projects for "lobbying expenses." This happened before the war. The witness gave no later examples of lobbying being included as a construction cost, but made the vague statement that there are many others.

In Wednesday's hearing W. V. King, chief accountant of the commission, went over much the same ground that Mr. Russell had covered on the day previous, urging more strict accounting of project net investments. He averred both that the commission had been remiss and that the power companies had obstructed efforts to obtain figures. He cited several instances of questionable entries in capital accounts. The companies named included the Northern Connecticut Power Company and the Niagara Falls Power Company. Sums paid to H. J. Pierce for lobbying were, Mr. King said, included in the latter's valuation figures. One of the committee members pointed out that many of these charges should logically be subject to court decisions, which may uphold them. Mr. King challenged Mr. Bonner's contention that the field personnel of the three executive departments are able to handle necessary investigations without the help of a special staff of accountants.

ULTRA-VIOLET RAYS GUARD OFFICE SAFE

—Wide World Photos.

Interception of ultra-violet or invisible light rays from a concealed source by any opaque body will set alarm bells, signal systems or tear-gas barrages in operation through the functioning of this photo-electric cell. James L. McCoy, research engineer, Westinghouse Lamp Company, gives a demonstration to illuminating engineers.

Chairman Couzens declared during the questioning of Mr. King that "conditions in the commission have become so intolerable that it presents one of the rottenest exhibitions of government I have ever heard of," and Secretary Wilbur, in a statement made in the office of the Interior Department, admitted that "an unsatisfactory and inharmonious situation exists in the staff of the Federal Power Commission."

Before the hearings close several other commission employees will be called, and probably the Secretary-commissioners will be asked to present their views.

Muscle Shoals Lobbying

FURTHER testimony on the work of the Tennessee River Improvement Association concerning Muscle Shoals legislation was given before the Senate lobby committee during the latter part of last week as W. G. Waldo, consulting engineer and secretary of the organization, was subjected to intensive cross-questioning. A fact brought out in the questioning to which some seemed to attach importance was that Charles E. Hughes had been called upon to draft the contract through which the American Cyanamid Company hopes to gain control of the Shoals. It was not made clear exactly what blame was attached to this.

Mr. Waldo's concluding testimony dealt mainly with the lobbying and publicity work of the association. For example, a document written by him was shown to have reappeared as the main body of a report on Muscle Shoals rendered by the House committee on military affairs. The witness denied having drafted it for that purpose. Methods of approach to Senators and Representatives also were discussed.

Claudius H. Huston, chairman of the Republican National Committee, was identified with attempts to promote development of the Aurora power project on the Tennessee River by correspondence produced on February 19 by Senator Black of Alabama. Senator Black read into the record letters written in 1928 by Colonel J. W. Worthington indicating that both he and Mr. Huston were endeavoring to attract capital to the project.

Application for a preliminary permit for development of the Aurora project was filed with the Federal Power Commission on August 13, 1928, in the name of Robert H. McNeill. Situated on the Tennessee River near Aurora Landing, Tenn., the dam, in conjunction with Dam No. 53 on the Ohio River, would provide navigation from the mouth of the Tennessee River to Pickwick Landing, a distance of 206 miles, and have an initial installation of 220,000 hp.

Senator Black also read a letter dated July 25, 1927, in which Colonel Worthington reminded Mr. Huston "that you and I in the fall of 1925 did our utmost to bring the power and chemical groups together and we made a dismal failure." The letter said also that "Mr. Hoover [then Secretary of Commerce] even undertook to bring these interests together through Owen D. Young and failed."

In a session on February 18 the House committee on military affairs decided to hold further hearings on the bills now pending for the disposition of Muscle Shoals. William Bell is expected to testify again next Tuesday, February 25, concerning the Cyanamid offer. Members of Congress sponsoring other plans also will appear.

Secretary Wilbur Explains Stand on Boulder Dam Power

EXPLAINING his position as to Boulder Dam power contracts, Secretary Wilbur conferred on February 15 with the members of the Senate and House committees on irrigation and reclamation. Most of the committee members present concurred with Mr. Wilbur's tentative plan, although Senator Pittman of Nevada spoke in favor of an alternate scheme shaped to promote industries in Nevada and Arizona.

The Secretary's allotment would give 50 per cent of the power to the Metropolitan Water District of southern California for pumping, 25 per cent to Los Angeles and 25 per cent to the Southern California Edison Company. These percentages shape the cut which would remain after the preference rights have been exercised through which Arizona and Nevada each could take up to 18 per cent of the power and the applicant municipalities in California 4 per cent.

Senator Pittman wants to divide the 550,000 firm horsepower dealt with by the Secretary of Interior equally between California, Arizona and Nevada. Of the estimated 100,000 hp. additional, he would give Utah and New Mexico 40,000 hp. each and 20,000 hp. to California. Anything above 650,000 would be split evenly between the five states.

It is generally assumed that the Wilbur plan, based on a waiting market, will be used in preference to the other, which would depend on extensive developments in the future. Meanwhile the Interior Department's legal assistants are working on contract forms which soon will be submitted to the parties desiring to enter contract at this time. Just what action will precede the final signing is yet to be determined.

According to sources of information accepted in Washington, the Colorado Lower Basin states seem nearer than ever before to an agreement on water allocation.

Utility Chiefs Deny Russell's Allegations

FLOYD L. CARLISLE, chairman of the board of directors of the Niagara-Hudson Power Corporation, has sent a letter to Senator Couzens asking a hearing before the interstate commerce committee of the Senate. Mr. Carlisle desires an opportunity to answer the charges of inflated valuations made by Charles A. Russell, solicitor of the Federal Power Commission, against the Niagara Falls Power Company. John J. O'Brien, president of H. M. Byllesby & Company, issued a broad denial of statements made by Mr. Russell reflecting on that organization. He called them "aboslutely and unqualifiedly a misstatement of fact."

▼

Small Slide on Saluda Dam Starts False Rumors

A SLIDE occurred on the downstream face of the Saluda Dam, now being constructed about 14 miles from Columbia, S. C., at 7 o'clock Wednesday morning of this week, starting sensational rumors that the dam had broken. The slide, however, had nothing to do with the reservoir proper, only a very small portion of the downstream dike giving way.

According to A. S. Crane, hydraulic engineer of the development, the slide was caused by raising the water too high in the segregation pool which is used for sluicing purposes. This softened the material on the downstream face and several thousand cubic yards of earth slid downstream, taking about 1,000 cu.yd. of the material from the pool and all the water which the pool contained. A considerable amount of the material was carried into the power house which is now under construction, and several unimportant structures near the power house were destroyed.

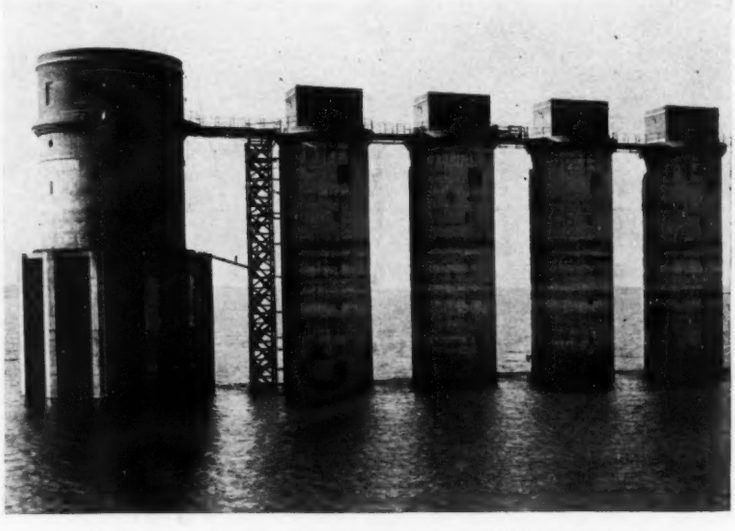
Between 200 ft. and 300 ft. of the earth fill on the downstream dike was affected. The fill on top of the dam, where the washout occurred was only about 20 ft. high. The upstream side of the dam was not affected in any way. This upper portion is now approximately 187 ft. in height, or within about 20 ft. of the ultimate height.

Two hours after the slide occurred some of the gates in the intake towers were opened in order to clear the deposits of mud that had been made around the power house downstream from the dam.

▼

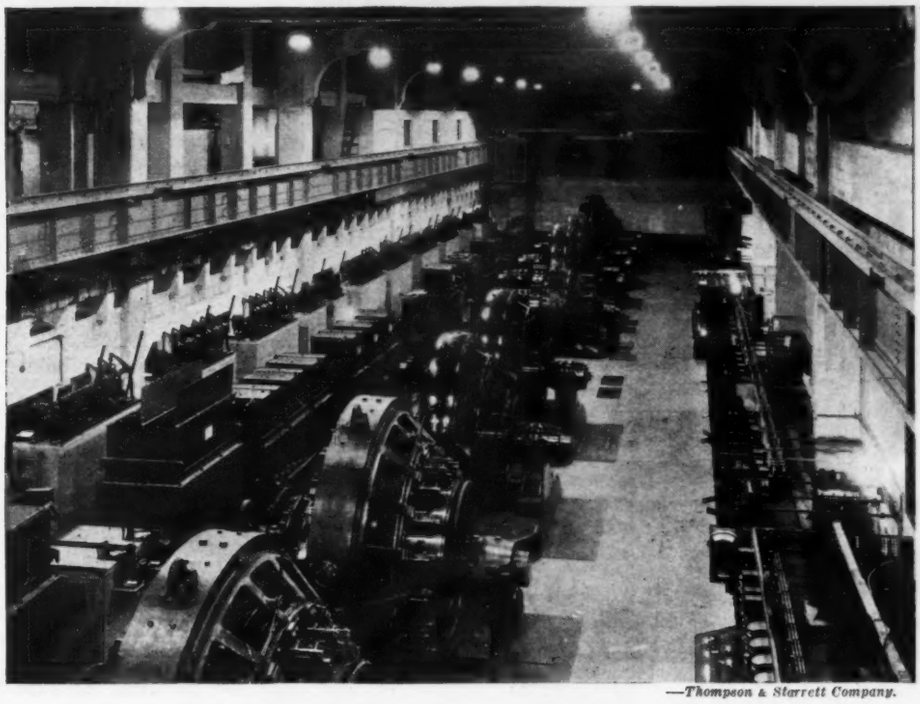
Spokane Meeting Makes New Proposal to N. F. P. A.

INDORSEMENT of the view put forth in a paper by L. W. Going, chief electrical inspector of Portland, Ore., to the effect that the prescription of requirements for adequacy in feeders, branch circuits and outlets was a function of the National Electrical Code was the principal action taken by the convention of the Commercial Section of the Northwest Electric Light and Power Association, held at Spokane, Wash., on February 13 and 14. A resolution was passed embodying this idea and recommending consideration of it by the electrical committee of the National Fire Protection Association, as a means of offsetting the retarded development of the industry due to inadequate wiring.



Intake towers on Saluda Dam, near Columbia, S. C.

Railroad Substation Built on Bedrock



—Thompson & Starrett Company.

ONE of the most remarkable substations in existence has just been completed 100 feet under the sidewalks of New York, at Forty-third Street and Lexington Avenue, by the New York Central Railroad Company. This substation, which takes the place, but on a larger scale, of one at Fiftieth Street, demolished to permit building operations, not only supplies energy to hundreds of trains every day but also lights a group of large terminal buildings. It was installed without any cessation of service to either the railroad or the buildings. Full electric, hot-water supply and heating service was maintained while the equipment was moved.

The operations were completed ahead of the scheduled time, with the co-operation of the builders—the Thompson-Starrett Company—and of General Electric engineers. F. B. Freeman, chief engineer for the New York Central's Buffalo and East division, was in charge.

Moving the equipment necessitated a piece-by-piece lowering process down a 50-ft. drop from the unloading platform to the substation main floor. Three 4,000-kw. armatures, each weighing 29 tons, were thus lowered. A second major problem confronting the engineers was the transfer from Fiftieth Street of an 8,000-amp. electric storage battery made up of 150 cells. Each cell weighed 4,550 lb. and was filled with sulphuric acid. The top surface acid only was removed, wheels were placed under the tanks, and the entire battery was hauled seven blocks and installed.

The electric substation as it now stands consists of this battery, of five General Electric rotary converters for railroad power and of five other converters for lighting and elevators. The total weight of the equipment installed in the new substation is 850 tons.

The problem of shifting the electric feed was solved by the construction at Forty-ninth Street of a circuit-breaker house with switchboards under distant control through twelve heavy cables from Forty-third Street.

▼

Proposal to Terminate Hartford Voting Trust

HOLDERS of three-fourths interest in voting-trust certificates have agreed to terminate by March 15 the trust controlling the Hartford Electric Light Company. The certificates will be exchanged for free stock. President Samuel Ferguson says that conditions in the public utility field have so changed since the formation of the trust as to make its continuance no longer necessary as a protective measure. Without such justification it is deemed desirable to eliminate the complexity of two classes of securities and the differential in market quotation which has caused an unfavorable condition for the depositing stockholders.

The Hartford interests lately became identified with the management of the Stamford Gas & Electric Company and for several years have controlled the Connecticut Power Company, thereby establishing a strong group of properties under common direction.

▼

Spectacular Plans for Chicago Electric Exhibit

ELECTRICAL engineers appointed by the National Research Council recently met to discuss plans for the electrical part of the Chicago World's Fair of 1933 to commemorate the centenary of the city and the progress of the arts. A suggestion was put forth for a "circular temple of electricity," 600 ft. in diameter and divided into 32 theaters, the audiences being moved by mechanical means before as many stages, on which the important phases of electrical development would be shown. This exhibition, it was calculated, would occupy two and one-half hours. Within the temple, if it be built, artificial lightning may be hurled against a 220-kv. transmission line for the delectation of the spectators. It it also planned to build large models of steam-electric and hydro-electric stations, including one of the State Line power house on the Indiana-Illinois boundary.

Thirteen prominent electrical engineers attended the meeting, R. F. Schuchardt, chairman of the committee in charge, presiding.

OTTAWA WELCOMES SNOWSHOERS ROYALLY

—Wide World

Illumination of the Peace Tower and Parliament Buildings at Ottawa, Canada, in honor of the international convention of snowshoers was a recent governmental good-will gesture. The snowshoers came from New England and eastern Canada.

All-Lawyer Commission Proposed for Kentucky

TWO bills affecting public utilities have been introduced into the Kentucky Legislature, one calling for the creation of a public service commission and the other for submission in 1932 to the voters of a constitutional amendment to permit the powers of the existing Railroad Commission, which has no authority over power companies, to be vested in the new body.

By the terms of the bill first named a commission of three members who must be lawyers of ten years' standing would be appointed by the Governor elected in 1931. It would have jurisdiction over valuation and rates. The appointments would be made on or before January 1, 1932, and would be subject to confirmation by the General Assembly. Salaries would be $5,000.

The utility interests seem rather indifferent to the matter, their only argument being that if such a commission should be formed, it would be essential, despite the small salaries, that men of practical and theoretical knowledge of the problems involved be named.

▼

A. E. C. Now Studying Communications Bill

SENATOR COUZENS' bill providing for the organization of a new federal regulatory commission to be called the Federal Commission on Communications and Power is opposed in a progress report of the committee on communications of the American Engineering Council. Unified operation of communications systems, wire and wireless, under government regulation is favored.

The council's committee, headed by Edwin F. Wendt of Washington, D. C., is making an exhaustive study of the proposed legislation, which is also being studied by many other national bodies of professional and business men, including the American Bar Association and the United States Chamber of Commerce. The A.E.C. investigators may take a year to complete their inquiry.

What is needed is a reorganization of existing governmental agencies and not more commissions, according to the report. "Experience shows," it says, "that federal regulatory commissions constantly advocate the extension of their powers and functions and build up large organizations which in some instances parallel the work of the regular departments of the government." It says also: "The council should not favor federal regulation which deprives the states of their legitimate powers over intrastate business."

The members of the council's committee include O. H. Caldwell of New York, former member of the Federal Radio Commission; A. J. Hammond of Chicago, Dean Kimball of Cornell University, C. B. Hawley of Washington and Frank A. Scott of Cleveland.

▼

Two Nebraska Rivers Fit Mainly for Irrigation

WHY hide irrigation projects under the camouflage of power, flood control or navigation? This is the question suggested by the preliminary report of Prof. Clark E. Mickey of the University of Nebraska, who has been conducting the survey of the Platte and Republican Rivers ordered at the last session of the Legislature to cover the four points named. Professor Mickey says that power, while important on the Platte, will play a very small part in development along the Republican, because the latter's tributaries are too fluctuating and at times without any supply. In the Platte Valley it will be necessary to siphon the water to reservoirs in canyons near by, the low, soft banks preventing such use elsewhere without danger of flooding great areas. The real benefits, he adds, are to be derived from irrigation.

Upstate New York's Two Big Power Systems

RENEWED recommendation is made by the New York Public Service Commission in its annual report, just filed, that its jurisdiction be extended to cover holding companies, though the arguments are not repeated. On the subject of "Electric Service" the report says in part:

The past year has brought the most extensive activities in consolidation of electric corporations and the grouping of such corporations which have been seen in the history of the state. Practically two interests now control in the upstate area, viz., the Niagara-Hudson group, which comprises the Niagara Falls system, the Syracuse, Utica, Northern New York Utilities, St. Lawrence County and New York Power & Light systems, and the Associated group, which includes the New York State Electric & Gas Corporation, the Empire Gas & Electric Company, the Elmira Water, Light & Railroad Company, the New York Central group of companies, the Rochester Gas & Electric Company group, the Plattsburg Gas & Electric group and the Harlem Valley group. The Consolidated group covers greater New York and Westchester County, and the Long Island Lighting Company serves the entire island outside of greater New York, excepting that portion served by the Patchogue Electric & Power Company.

Rural rate extensions have been filed so that there exists in the state today for almost its entire area a rural rate plan based on a guaranteed revenue per mile of line divided between the customers served by each extension. In general, this revenue

is $24 per month per mile of line. The Rochester Gas & Electric Corporation is the only corporation which has not adopted this form of extension plan or a modification of it. Such corporation adheres to a plan of spending three times the estimated revenue to be received annually from the line in question and asks the prospective customers to contribute the difference between the amount and the actual cost of the line. The experience had with the guaranteed-minimum-revenue plan indicates that it is much to be preferred to any other, and it is believed that by the end of the year 1930 the state will be served by a single type of plan.

Alluding to the necessity of supplementing water power by steam in the Niagara peninsula and elsewhere, the commission says:

Obviously there are but two alternatives open to the power corporations. These are, first, the gradual withdrawal of all hydro power from wide distribution, leaving communities at long distance to find other sources, or, second, the supplementing of hydro power by adequate steam stations. Depending upon the character of the hydro plant with respect to regularity of output, this situation may result in the development of steam stations as the source of firm power, with the hydro stations being utilized as peak power sources.

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Cheat River Project Is Expounded and Opposed

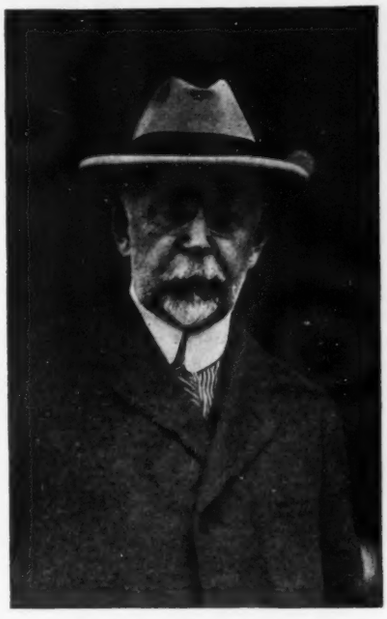
ON BEHALF of the West Virginia Power & Transmission Company, a subsidiary of the West Penn Electric Company and the American Water works & Electric Company, the West Virginia Public Service Commission was told, in the course of a recent hearing on the company's application to engage in extensive water-power development on the Cheat River watershed, that the applicant will introduce an alternative proposal to combine what were described as the St. George and Rowlesburg projects into one project to be located above the town of Erwin, in Preston County. The applicant's present plans were described in the ELECTRICAL WORLD for December 28, 1929 (page 1291). An eventual output exceeding 600,000 hp. is said to be involved, costing $100,000,000, and a system of lakes would be created from the Pennsylvania-West Virginia border to Parsons, W. Va., covering a total area of 35 square miles.

A formal protest against the development was filed by the Western Maryland Railway, which said that such exploitation of the Cheat River would jeopardize operation and extension of the railroad. Conferences led to the withdrawal of the protest in the case of the three Blackwater projects in Tucker County, which will be the first to be undertaken. The commission hearing was adjourned indefinitely.

Freeman Leaves S.E.D., Edgar Temporary Head

WITH the meeting of the board of directors of the Society for Electrical Development held in New York on February 12, W. W. Freeman ended his tenure of office as president. As recorded under "Men of the Industry" last week, Mr. Freeman has become chairman of the board of the Intercontinents Power Company. This places his direct business interests entirely outside the United States, a fact which he considered rendered him ineligible for the renomination proffered him.

Charles L. Edgar, president of the Boston Edison company, was made acting president. He paid a tribute to his predecessor, saying of the latter's ten-year presidency:



Charles L. Edgar

His has been a vision of a united industry working together for a common end. He envisioned the society as the medium for translating that vision into a practical working reality. The way has not always been smooth. It does not take long to get together an organization and the money to produce and promote some useful product, with profit as a motive, but ideas such as the society represents, fundamental in character and affecting an entire industry, are in the very nature of the case slower in their evolution. That evolution in our industry has been quickened by the unselfish sterling qualities of W. W. Freeman, which have commanded the full confidence of all branches. He has bestowed a rich legacy of leadership, and I hope his wise counsel and ability to harmonize will still be available on the board for a long time to come, even though less actively.

The presidents of the national associations and chairman of the League Council were elected vice-presidents in the following order: L. E. Mayer, R. Bourke Corcoran, C. L. Collens, G. E. Cullinan and M. S. Sloan.

Encouraging reports were presented. "Red seal." results in 1929 totaled 60 per cent of the total for all four preceding years. The companion activity in the commercial and industrial field—"Franklin-red seal"—is under way and giving evidence of effectiveness.

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Low Power Rates Needed in New York, Hart Says

A LETTER has been sent to the Water Power and Control Division of New York State by Merwin K. Hart, chairman of a committee of twenty-five of the New York State-Wide Economic Congress, setting forth the view that upstate industries are declining and that there is need for the lowest possible rates on power from the Niagara River. Mr. Hart concludes:

Low-cost power has always been an aid to industry, that is to say, an aid to the building up and maintaining of the opportunity for employment; and, conversely, high-cost power has been a burden and has injured the opportunity for employment. The issue is not one between the state and the power companies, as I am informed the power contracts provide that any additional water rental shall be assumed by the customers. And it is certainly not an issue between the state and the power consumers, because these power consumers in their very use of power will furnish employment, which is most necessary in the state today. The issue is between the state, with its desire to collect taxes, and the workers themselves.

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Kansas Company Strikes Snag in Crossing Border

INTERSTATE service has received a jolt in Missouri, where the Public Service Commission refuses to accept the rate schedules filed for eleven central Missouri towns by the Western Power & Light Corporation of Salina, Kan. The commission's refusal to sanction the proposed rates for these places was on the ground that the utility company is attempting to put into effect higher rates than were set out in its franchises with the cities, signed a year ago. The commission also found that the Kansas company had been serving the cities more than two months without its sanction, necessary under state laws. Rate experts will confer with city officials who brought the charges of violation of franchise against the Salina company, and attorneys for the Western Power & Light Company have been ordered to explain the alleged violation of the Missouri utility laws.

ELECTRICITY VS. FOG

—Keystone View Co.

From a photograph taken recently at 6 p.m. at a subway entrance on Piccadilly, London. Think of the old days of street lighting by gas!

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Maine Commission on Interconnection Benefits

OUTSPOKEN approval of the policy of Maine water-power companies in interconnecting their transmission lines so as to take advantage of differing periods of high and low water and thus reduce the need for using steam standby plants was expressed recently by the Public Utilities Commission of Maine in giving its assent to a bond issue desired by the Cumberland County Power & Light Company of which the proceeds were to be used in part for completing interconnection with the Central Maine Power Company. The commission said:

It was found by observation and after a careful study of the run-off of the Saco River, upon which is located the hydro-electric plant of the Cumberland County Power & Light Company, and of the Androscoggin and Kennebec Rivers, upon which are located hydro-electric plants of the Androscoggin Electric Company and the Central Maine Power Company, respectively, that the high and low water conditions occurred at different seasons of the year.

In order to take advantage of those conditions, the Cumberland County Power & Light Company and the Androscoggin Electric Company in 1924 built an experimental interchange high-tension line extending from Lewiston to Portland and connecting the systems of the two companies. It was found by experiment that the Cumberland County company at certain seasons of the year could obtain from the Central Maine Power Company enough electrical energy to supply its customers, thereby obviating the necessity of starting its steam generating plant, and that the Central Maine company could procure electrical energy from the Cumberland County company, obviating the necessity of generating electricity through its steam plant at Farmingdale.

The interchange of power over this experimental line has been found to be so advantageous to the companies involved that it was decided by the Cumberland County and Central Maine companies to build a new interchange high-tension line connecting the lines of the Central Maine company in Lewiston with the lines of the Cumberland County company in Portland.

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Agitation in Nebraska on Utility Law and Rights

FORMAL refusal to assume jurisdiction over electric rates and service outside of municipal limits in the state has been entered by the Nebraska Railway Commission and existing complaints have been dismissed. The commission opinion sets out that if the Legislature desires to enlarge its function it should say so "in clear, definite and unmistakable terms." Although the Attorney-General has held that properly interpreted the various sections of the law do confer that authority where service is already established, the commission prefers to wait until the Legislature reassembles.

Fremont city officials are endeavoring to upset the purchase by the Nebraska Power Company of plants at three towns hitherto served by the Fremont municipal plant. At North Bend the voters approved overwhelmingly a proposal that the power company pay $110,000 for the town plant. Fremont officials say that the North Bend plant is worth not to exceed $30,000 and charge that by paying excessive prices at the other points the power company has obtained possession and then canceled the Fremont contracts, thus causing the city heavy loss. For doing this at the three towns $75,000 damages is sought, while the court is asked to enjoin permanently the purchase at North Bend, of which the Council has temporarily refused its approval. It is charged that the power company is pursuing unfair methods of competition and seeking to create a monopoly. In power circles it is said that this method is necessary to fight the municipal plant monopoly planned through a state-wide hook-up.

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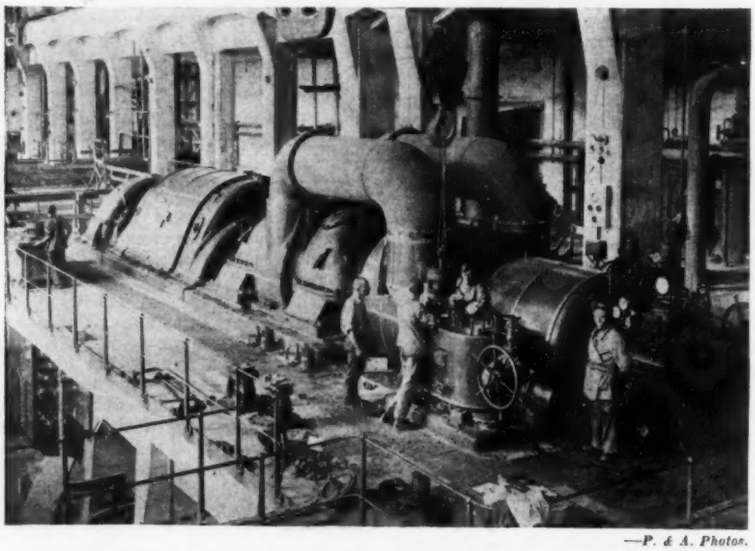
Germany to Import Norwegian Water Power

GRANDIOSE schemes for exporting Norwegian water power to Germany are reported in recent news dispatches. Upward of 800,000 hp., it is asserted, could be generated through harnessing three great waterfalls in the districts of Telewarken and Soerlandet. This energy, according to the promoters of the plan, would be transmitted through Sweden and across the Baltic to Sassnitz and Luebeck, Germany, where substations would be built. An alternative proposal is to transmit the electricity to Germany across Denmark. The total cost of the project is estimated at $93,000,000.



—P. & A. Photos.

INSIDE A RUSSIAN GENERATING STATION

Electricity is destined to play a great part in the new Russia, indusrially and perhaps politically. The Shterovka power house at Moscow is one of its manifestations. A 22,000-kw. generator is shown.

Coming Meetings

North Central Division, N.E.L.A.—Engineering Section, Nicollet Hotel, Minneapolis, Feb. 24-25. J. W. Lapham, 803 Plymouth Bldg., Minneapolis.

Oklahoma Utilities Association — New Tulsa Hotel, Tulsa, March 11-13. E. F. McKay, 1020 Petroleum Bldg., Oklahoma City.

Northwest Electric Light and Power Association — Accounting Section, Portland, March 17-18; Engineering Section, Aberdeen, Wash., March 26-28. B. Snow, 1206 Spalding Bldg., Portland, Ore.

Illinois State Electrical Association—Hotel Abraham Lincoln, Springfield, March 19-20. George Schwaner, 205 Illinois Mine Workers' Building, Springfield.

Pacific Coast Electrical Association—Commercial Section, Fresno, Calif., March 20-21. G. T. Bigelow, Southern Sierras Power Co., Riverside, Calif.

Southeastern Division, N.E.L.A.—Bon Air-Vanderbilt Hotel, Augusta, Ga. April 15-17. C. M. Kilian, 207 Bona Allen Bldg., Atlanta, Ga.

Middle West Division, N.E.L.A.—Fort Des Moines Hotel, Des Moines, Iowa, April 23-25. Thorne Browne, 1527 Sharp Bldg., Lincoln, Neb.

Southwestern Division, N.E.L.A.—Hot Springs, Ark., May 6-9. S. J. Ballinger, San Antonio Public Service Co., San Antonio, Tex.

American Institute of Electrical Engineers—District meeting, Springfield, Mass., May 7-10; summer convention, Toronto, June 23-27. F. L. Hutchinson, 33 West 39th St., New York.

National Electrical Manufacturers' Association — The Homestead, Hot Springs, Va., May 18-23. E. H. Hubert, 420 Lexington Avenue, New York.

East Central Division, N.E.L.A.—Hotel Statler, Cleveland, May 20-23. D. L. Gaskill, Greenville, Ohio.

American Electrochemical Society — St. Louis, May 29-31. C. G. Fink, Columbia University, New York.

National Electric Light Association—San Francisco, June 16-20. A. J. Marshall, 420 Lexington Avenue, New York.

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Architects Are to Join in Lighting Conference

CO-OPERATION of architects, fixture manufacturers, contractors and lighting engineers will be furthered by an architectural lighting conference to be held on March 12 to 14 under the auspices of the commercial and industrial lighting committee of the N.E.L.A. at the Westinghouse Lighting Institute, Grand Central Palace, New York. Well-known architects will take part, and a well-considered effort to bring architects and electrical men into closer association for mutual benefit will be made.

Among papers by architects scheduled are: "The Future Trend of Lighting," by Foster Gunnison; "Fundamentals of Architecture as Related to Lighting," by Raymond M. Hood, and "The Importance of Artificial Light to Architecture," by Wallace Harrison. The electrical point of view will be given by W. H. Horton, Jr., P. S. Clapp, A. L. Powell, Ward Harrison, D. W. Atwater, J. W. Barker, L. W. Davis, H. H. Magdsick, H. C. Reutschler, C. L. Law, Earl Whitehorne, M. E. Skinner and others. James T. Holmes and Walter W. Kantack will discuss interior lighting practice from the manufacturer's standpoint.

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Seattle's Experts Make Many Recommendations

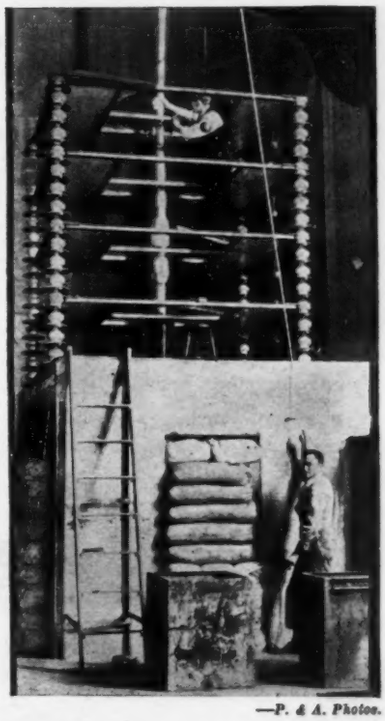
COMPLETE reorganization of the municipal light department of Seattle under either a superintendent or a non-salaried utility commissioner is recommended in a report recently submitted to the City Council by Lybrand, Ross Brothers & Montgomery, the city's efficiency experts. Division of departmental administration is proposed along three lines, with an executive superintendent at the head as follows: (1) Commercial and financial division; (2) operating division; (3) engineering division.

While many criticisms of the accounting and operating methods of the department were contained in the report and copious recommendations were made, rumored sensational charges were not forthcoming. The accounting system was, however, found to be cumbersome and inefficient. No inventory of materials at the warehouse had been taken for more than six years. Subsidiary ledgers were out of agreement with controlling accounts. Of the domestic accounts, 44 per cent were past due or delinquent, and half the commercial lighting accounts were past due, as were 32 per cent of the power bills.

Superintendent J. D. Ross, who made a simultaneous report, promised to study the recommendations in a constructive spirit. He charged that interference from the City Council and the city engineering department had been responsible for many costly mistakes and delays connected with city lighting affairs for which he personally had been forced to bear the blame.

The experts touched upon competition in the electric power field and the possibility of combining both publicly and privately owned local plants. If such a step should be taken, it was urged, "millions of dollars would be saved by early plans looking toward that end." If there can be no consolidation of local power plants, the experts proposed a conference between responsible heads of the city and the private power plant to eliminate conflict and duplication as far as possible.

X-RAYS AT 1,000 KV.



—P. & A. Photos.

Said to be the most powerful apparatus of its kind yet made, X-rays from this machine, recently installed in the laboratory of the California Institute of Technology by Charles C. Lauritsen, can penetrate an inch of lead.

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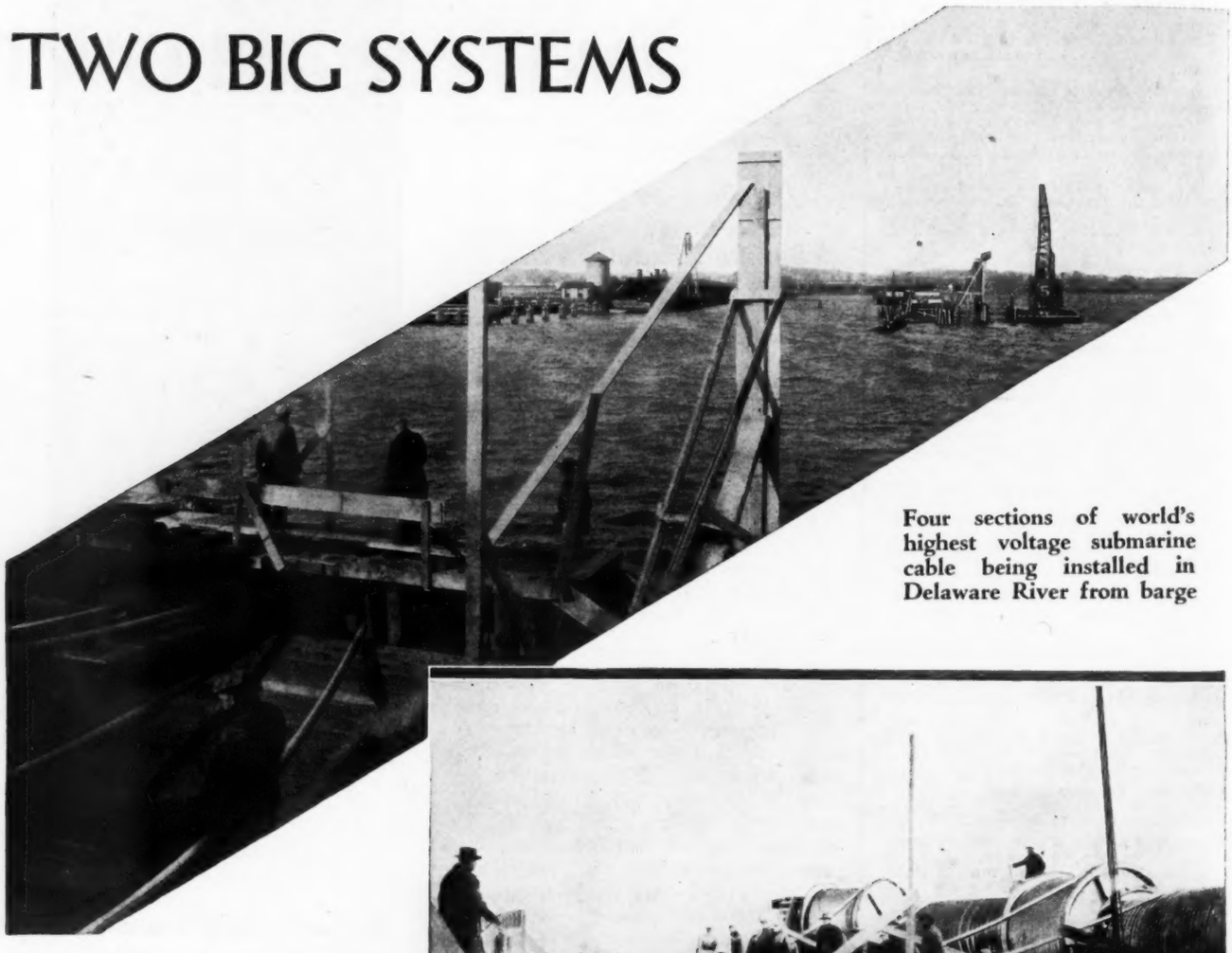
Kettle Falls to Generate 240,000 Hp. Eventually

COMPLETION of a tentative draft of the final plans for the development of the hydro-electric site at Kettle Falls on the Columbia River in northeastern Washington and the filing of these plans with the Federal Power Commission with the application for a license have been announced by Miles W. Birkett, vice-president and general manager of the Washington Water Power Company.

The Kettle Falls are about 40 ft. in height and an ultimate head of 75 ft. can be obtained through damming. The Columbia River at this point has a low-water flow of about 20,000 sec.-ft. and a flood of about 300,000 sec.-ft. normally. The development is planned in ten stages with a 35,000-hp. initial installation and an ultimate development at about 240,000 hp. A date may be set for beginning work on the project following the issuance of the federal permit.

JOINING TWO BIG SYSTEMS



Four sections of world's highest voltage submarine cable being installed in Delaware River from barge

THE 75,000-volt cables to carry 60,000 kva. per circuit were manufactured in 4,000-ft. lengths without joints—an outstanding achievement both in regard to working voltage and length. They connect the U.G.I. and American Gas & Electric systems. Eight cables in all, two three-phase circuits and two spares, were buried under the river bottom in a trench 40 ft. wide and 10 ft. deep, which was then back-filled.

EDITORIALS

L.W.W. MORROW
Editor

Frankness Disarms the Skeptic

EFFORTS of utility executives to be wholly candid and to supplant the divergent interests of their investors and their consumers by a wholehearted attitude of co-operation have much too often been viewed with suspicion by a cynical minority.

But the assurances of Floyd L. Carlisle, chairman of the Niagara-Hudson Power Corporation board, in addressing a public hearing at Albany on St. Lawrence hydro-electric development, sound entirely sincere. "We have no plan of our own," he said. "We own the riparian rights, and the riparian rights have a great relation to the problem, but our motive, our theme, our desire is to see the development of the St. Lawrence made, not to any one particular plan, but to the cheapest plan and to the best plan, and whatever that plan is, we are going to fall in line with it and cooperate with it and help."

Dissection of this statement fails to disclose any reservations or qualifications, expressed or implied, and it can be taken only as one of the frankest of possible statements from a source that might have interposed major obstacles to any scheme advocated by the prospective commission, if it had been contrary-minded. Enunciation by utility heads of similar principles regarding debatable questions would do much to relieve any tension existing in other quarters.

As Mr. Carlisle also emphasized in his Albany speech, the state-wide economic benefits derivable from hydro-electrification of the river lie wholly in the stimulation of enough large-scale industrial establishments close to the river to absorb the bulk of the power. Only as a by-product of developments primarily for industrial use can electric power, particularly St. Lawrence or Niagara hydro, be made available to householders elsewhere in the territory at the lowest cost.

The next move is to ascertain the relative economic merits of new power from the St. Lawrence, additional power from Niagara and more power from steam sources.

The Law May Change Its Viewpoint

IT LOOKS as if the gap between the engineer and the lawyer might be narrowed if some of the awakenings in the field of law sooner or later result in a remolding of its philosophy and aims. The law schools of Yale and Johns Hopkins are already participating with their medical, economics and political science staffs in an effort to break down the artificial barriers between the various fields of learning. Columbia's dean, in advocating a similar enterprise, avers that "social policy" is formed largely by legislators and judges, although neither of these agencies utilizes "the valuable knowledge of the economist, the historian, the psychologist and the philosopher in determining this policy." He might well have added the engineer to this list.

In fact, the engineer is largely responsible for the complexity of modern life and for the fact that the material world has outstripped the capacity of the non-material world to resolve the problems which engineering has created. The engineer is conscious of his responsibility to pool his analytical and organizing capacities with the caution and conservatism of a forward-looking legal profession, with the humanity of the medical and social-service worker and with sound economic

theory in order that a more adequate system of human relations may evolve.

Even though he moves mountains with ease, the engineer is well aware of the fact that public opinion, while lacking the attributes of mass, is nevertheless ponderable and can therefore be moved only slowly and deliberately. When it comes to the field of utility regulation, where the lawyer, the economist and the engineer meet on common ground, it is to be hoped that the progress toward clarity will be rapid. This should lie within the scope of expectation if some of Dean Smith's incisive phrases lead to early action. "Legal standards are often inconsistent with actual experience," is one of these. "Little time [in the law schools] is spent in ascertaining how the law is actually working" is another.

The engineer dares not apply nature's laws without adequate consideration of their consequences, both social and economic. The legislator and the jurist may well forget part of what the Romans did and contemplate present-day civil law in the light of its incompatibilities with physical, social and economic law.

Better Arrester Characteristics

TWO new types of heavy-duty lightning arresters have recently been placed on the market, known respectively as the "Thyrite" and "Porous Block" arresters. They have a smaller ratio of breakdown to cut-off and, in general, have precision in characteristics that permit reliable calculations to be made in advance. The new devices also seem to offer constructional and handling advantages that deserve attention. For one thing, they are much simpler than the older arresters. They are made up of units in series for high or low voltages. They require no protective hoods or skirts for outdoor service, but whether the all-porcelain outside will not be more subject to breakage only experience can tell.

Whether the new arresters are the results of the enormous amount of new data recently acquired in lightning study can only by surmised, but it may be safely assumed that careful consideration in the designs was given to the new knowledge, and it is therefore not amiss to hope that the new arresters will be a contributing factor to making transmission systems safer and interruptions through lightning less frequent.

Higher Voltages for Industrial Plants

MANY factories find themselves confronted with the same dilemma which faced small public utilities a few years ago and confronts some of the largest ones to this day. They are choked by low voltages. Experience has shown that in virtually all cases the future load turns out to be much greater than was estimated, and factories find themselves crowded with cableways that make it physically impossible to add any more cables and hampered by switchboards with several additions crowded into such small spaces as to make them permanent hazards. Such factories can learn from the experience of the utilities that they should discontinue hand-to-mouth extensions and undertake radical rehabilitation at higher voltages.

But, first of all, it is necessary for builders of new industrial plants to recognize the importance of sufficiently high voltages. Possibly they overlook the fact that 2,300, 6,600, and even 13,200 volts are less dangerous than 440 volts and 550 volts, because while workmen are quite careless with the lower voltages they treat those of 2,300 and more with more respect. The lowest distribution voltage in a factory of any size should be 2,300, so arranged as to be changeable to 4,000 volts as soon as the load grows. It would be preferable to go to 6,600 volts, because most equipment can be had for this voltage at very little additional cost over that rated at 2,300 volts, and the saving in copper and in losses is considerable. For the larger manufacturing establishments such voltages as 13,200 or even 33,000 should not be completely ignored.

The whole question of which are the best voltages for factories offers an extraordinary opportunity to the electrical engineer to be of great service to American industry. It is to be hoped that factory owners will appreciate this and avail themselves of the experience gained in the rehabilitation of public utility distribution systems.

A Billion and a Half Is Worth Attention

AN INTERESTING thing has been happening, little noted by most electrical men. It will be a surprising thought to many power-company executives, but it is a fact nevertheless, that the sales of merchandise to domestic users of electricity have far outgrown their purchases of energy. Consider the figures.

In 1929 the total sales of domestic energy to residence consumers were $656,000,000. But the total of appliance sales from all sources to these same consumers was $808,000,000. In other words, the appliance business was $152,000,000 bigger than the energy sales—and that's not all. For radio today is an energy-consuming appliance, and last year the total sales of alternating-current radio receiving sets were $727,000,000. This means that the American home spent $1,535,000,000 for electrical equipment to use around the house, which is $879,000,000 more than it spent for the supplying service. And a billion and a half dollars is two-thirds as much as the entire energy sales of the power industry last year for all purposes.

In other words, the retailing of electrical merchandise—including radio—to the American public has become a very large enterprise, a business in which the power companies have developed sales that totaled last year in the neighborhood of $212,000,000. It must be admitted, therefore, that the merchandising of appliances has become a very major interest in the commercial activities of the utilities. And yet there is a striking difference in the general attitude of the average executive toward this great merchandising business when compared with his point of view toward energy sales and the engineering, operating and financial phases of his job. It is at times a serious embarrassment.

True, the technical traditions of the public utility are older and more deeply rooted. Public policy is firmly established as an executive responsibility. Financial problems are basic and inescapable. But the economics of merchandising and the ethics of trade relations have now come to involve a matter of a billion and a half dollars of annual business in the electrical marketplace. That also is important, and power-company policy is the vital factor in its weal or woe. It is increasingly essential therefore that the commercial policy shall have the attention of the best leadership that the industry possesses and be supported in a measure proportionate to its present scope.

More Amperes for Street Lights

FOR many years the 6.6-ampere circuit has had the series street-lighting field to itself, but now it begins to look as though another entrant were about to dispute this time-honored supremacy. The 20-ampere circuit is looking up in an interested and inquiring way.

There are two reasons why the higher-current circuit is apparently more economical both in installation and operation costs. Both of these reasons raise disputatious questions, and possibly the arguments on them will do no more than arguments usually do, that is, confirm existing opinions rather than change them. But the genius of unrest still believes in seizing upon any advance that holds out hope of economy, as in this case.

The 20-ampere circuits do not require individual lamp transformers. To those who regard these transformers as simply a means to supply current to large-capacity lamps their elimination will be a distinct boon—something to shout about. On the other hand, engineers and operators who call these transformers "safety coils" and figure that their principal function is to isolate the lamp and fittings from the high-circuit voltage will not be wildly enthusiastic about cutting them out.

Moreover, those operators who think that no cable except metal armored is fit to put in a trench will contemplate the new non-metallic sheath cables with a cold and skeptical eye. While 20-ampere circuits will work economically only with a low-induction cable, the advances in cable insulation do not leave us wedded forever to metallic sheaths.

However the argument may rage, there can be no doubt that as high-intensity street lighting continues to be welcomed by enterprising merchants and civic improvement bodies there will be all over the country a growing acceptance of the high-current circuit.

By C. R. FUGILL
Westinghouse Electric & Manufacturing Company

Load Control Under Abnormal Conditions

INTERCONNECTION of transmission systems tends to develop an economic supply of power in a large area. With many links of high capacity in such a network it becomes necessary to control power flow, wattless energy, frequency and loading of lines and machines. Under normal conditions power should flow where it will in such a pool, but special conditions make it necessary to use equipment to control the several factors.

THE tap-changing transformer has proved useful in the development of these interconnections because it gives satisfactory voltage and phase-angle control without excessive cost. In this article there is given a method of analysis and a description of operation applicable to many interconnection situations involving the use of tap changers.

DURING the last few years the problem of interconnection of transmission systems has been given much consideration in Mexico. It becomes of increasing importance as the electrical companies continue to expand their transmission lines to take care of large irrigation projects. The power systems of the Guanajuato Power & Electric Company and of the Compañia Electrica Chapala (of Guadalajara), both of Central Mexico, have been interconnected by means of a 70-mile, 70,000-volt transmission line which the former company recently constructed from Ocotlan to Penjamo. This company has also constructed an additional 30-mile line from Penjamo to Irapuato to handle the increase in power which is now being fed into the Penjamo bus. At Penjamo there has been installed a 6,850-kva. Westinghouse transformer equipped for tap changing under load, which is believed to be the first of its kind in the Republic of Mexico.

The Guanajuato Power & Electric Company, which was the purchaser of the tie-in equipment, operates three stations with a total generating capacity of approximately 18,000 kva. The relative locations of these three stations, together with those of the Chapala system, are shown on the accompanying single-line diagram.

The Compañia Electrica Chapala has plants at Las Juntas, Puente Grande and El Salto, with a total generating capacity of approximately 28,000 kva. Its largest plant is located at the falls of El Salto on the Santiago River, which still has available about 200,000 undeveloped horsepower. The Chapala company also owns and operates approximately 300 miles of transmission and distribution lines.

The nominal voltage of the Chapala system is 70,000 volts, while that of the Guanajuato system is 60,000 volts. The voltage is not maintained constant on either system at Penjamo. The accompanying illustration shows the variation of the voltage for two typical days. The initial load being transmitted is approximately 1,000 kva., which later will be increased until a maximum of 6,800 kva. is reached. The power factor of the load at Ocotlan is normally from 85 to 90 per cent, the allowable variation being between 80 and 100 per cent.

In view of the small load to be transmitted initially and the power factor limit, it was found that 2½ per cent voltage taps on the tie-in transformer would not prove satisfactory due to the fact that the inaccurately matched voltages of the two systems would cause improper distribution of the reactive kva. A change in voltage of 2½ per cent might cause a change of seven or eight points in the power factor. Furthermore, it was necessary for the transformer to cover a 26 per cent range of voltage variation between the two systems. To use smaller taps with such a wide range to be

covered would have led to an extremely complicated and expensive design of the tap-changing equipment.

The transformer was designed for a voltage range from 60,400 to 72,450 on the Chapala side and 57,000 to 61,500 on the Guanajuato side. Eight 4.6 per cent taps were brought out from each phase on the low-voltage side adjacent to the neutral. In order to give a uniform regulation throughout the above voltage ranges step induction regulating equipment is used. This consists essentially of three single-phase induction voltage regulators and three series transformers equipped with double secondaries. By switching the series transformer along the taps and varying the voltage of the induction regulators an infinite number of positions can be obtained between taps. Excitation for the induction regulators is furnished by a 2,300-volt delta tertiary winding placed on the same magnetic circuit as the primary and secondary windings.

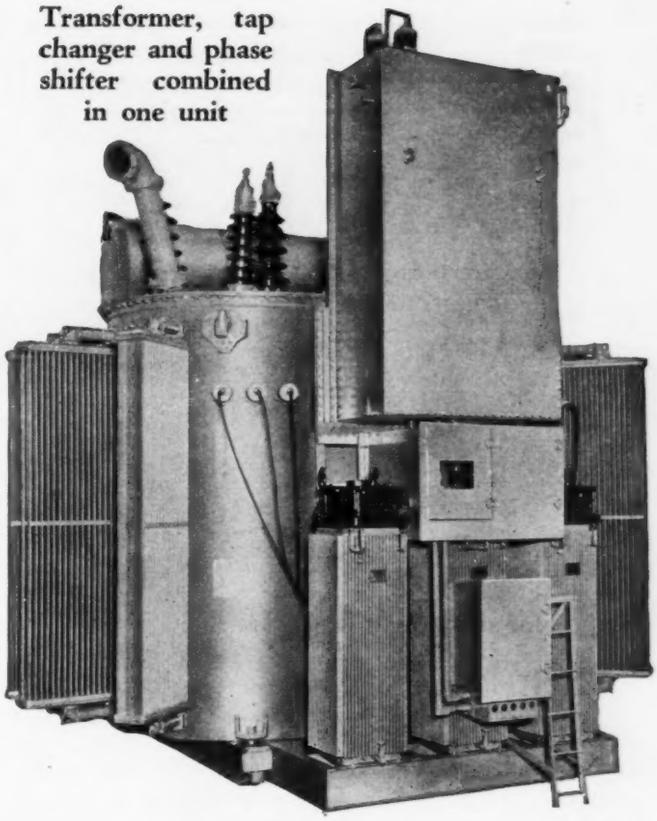
Typical operation

Referring to an accompanying illustration, *A* and *B* are the transfer switches on the double secondary series transformer *E*; *D* is the induction regulator and *C* is the delta tertiary winding. The two secondaries of the series transformer are wound in opposition.

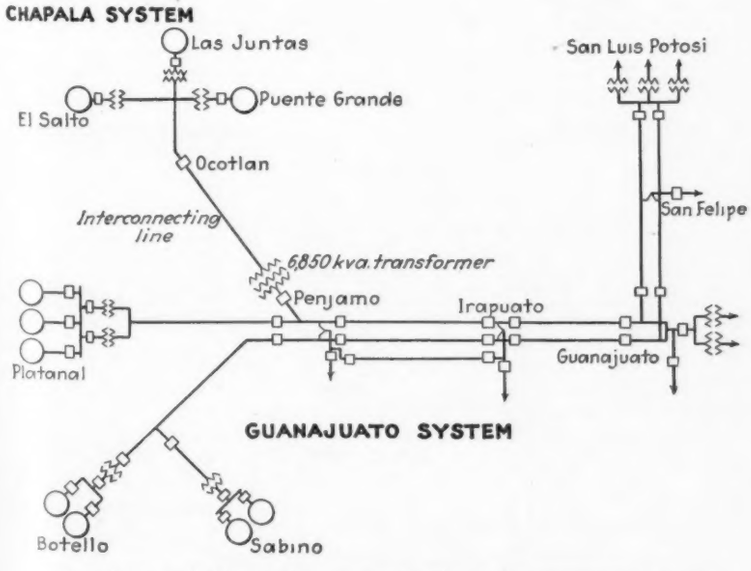
Assume that the voltage of the Chapala system is 66,000 and that of the Guanajuato system 58,000. The voltage of the secondary must be changed by changing the ratio of transformation so that the voltage, line to taps, plus or minus the voltage of the series transformer, will be exactly the same as the line to neutral voltage of the transmission line on the Guanajuato side. If the two voltages are not the same there will be a flow of wattless current due to this voltage difference. If the current is large the power factor will be materially affected.

Suppose a change in tap position becomes necessary. With the regulating equipment, for instance, set on tap No. 5, with transfer switch *A* closed, the secondary voltage would be too high and would cause the Chapala system to circulate reactive kva. to absorb the voltage difference. To lower the voltage, the primary of the regulator is moved to its maximum buck position, thus inducing in the series transformer secondary *S*-1 a gradually increasing voltage which subtracts from tap No. 5 a voltage equal to one-half the voltage between taps at the maximum position. The line to neutral voltage of the transformer is now the voltage of the secondary winding from line to the midpoint between taps No. 4 and No. 5, but this is slightly more than 57,000 volts. Secondary *S*-1 of the series transformer has a maximum buck voltage with respect to tap No. 5, but secondary *S*-2 has a maximum boost voltage with respect to tap No. 4, which also gives a voltage equivalent to the midpoint of the winding between taps No. 5 and No. 4. Since the potentials of the two points are the same, they may be connected together. Therefore, when switches 4 and *B* close, there will be no change of voltage at the time of transfer, so selector switch 5 will now open and the change in tap position is completed. The voltage can then be decreased further to get a very close adjustment by rotating the induction regulator rotor and thus subtracting a steadily decreasing voltage from the mid-point between tap No. 4 and No. 5 until the required voltage between lines is obtained.

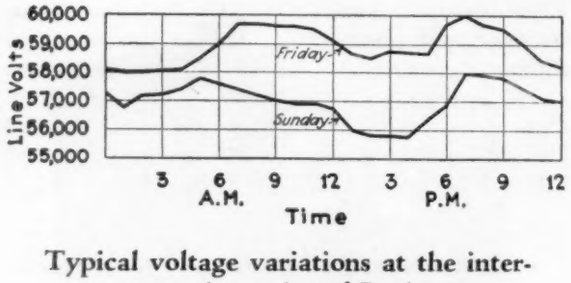
The transformer proper is of a conventional design, being a three-phase shell type. The regulating and tap-changing equipment, with the exception of the three



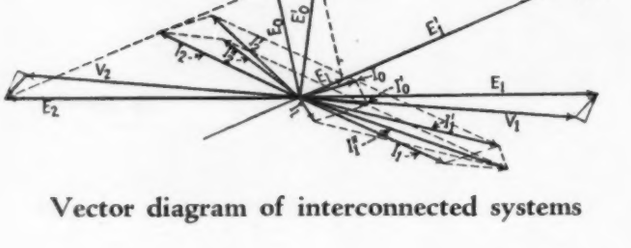
Transformer, tap changer and phase shifter combined in one unit



Sections of Guanajuato and Chapala power systems affected by interconnection



Typical voltage variations at the interconnection point of Penjamo



Vector diagram of interconnected systems

double secondary series transformers, is in a separate compartment fastened to the transformer tank. The series transformers are mounted near the top of the main core. The contactors are located in a separate oil-filled compartment, which keeps all moving parts outside the main tank. The general arrangement of the tap-changing mechanism is shown in the accompanying illustration.

The two systems are synchronized with the breaker at Penjamo. A synchronoscope is used for obtaining the proper phase relation, receiving its excitation from potential transformers connected to the delta tertiary and to the Penjamo bus. The inherent phase displacement of 30 deg. between the tertiary voltage and the secondary of the transformer is compensated for by using a Y-delta connected potential transformer at the Penjamo bus, which also gives a voltage 30 deg. out of phase with the bus voltage. The voltage of the tertiary, being excited by the Chapala system, gives a true indication of the primary voltage so that a voltmeter connected to the tertiary can be calibrated to read the primary voltage directly. The voltage of the Penjamo bus is read by means of a voltmeter connected to the potential transformer on that bus.

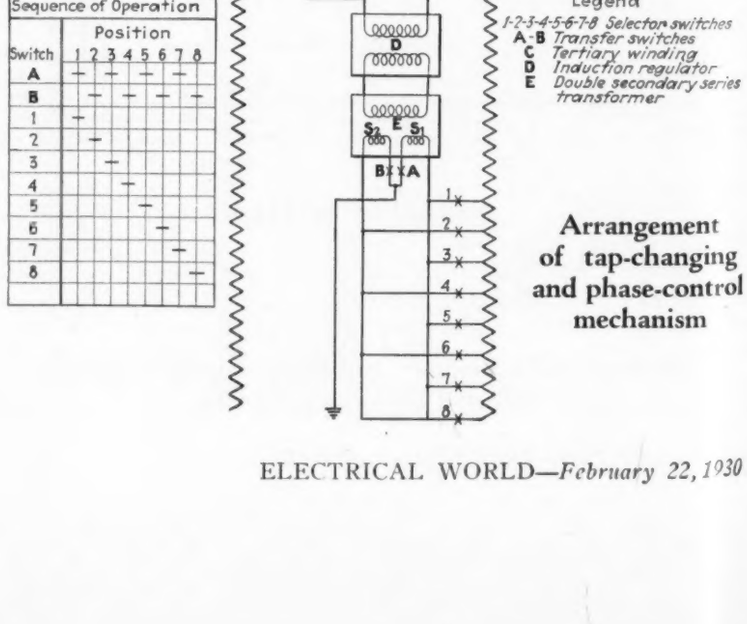
When the two systems are synchronized and paralleled, there may be a flow of circulating current if there is a difference in phase or magnitude of the two voltages. In the first case the flow of current produces synchronizing power tending to reduce the phase angle, but in the second case the main effect is on the power factor. A change of voltage then on either system will have no effect on the load carried, but it will cause a circulating current which is practically wattless with respect to the terminal voltages. Therefore, a power factor meter is used to give a measure of the correctness of the voltage adjustment between the two systems.

In the vector diagram let E_1 and E_2 be the excitation voltage of the two systems at no load. Assume that for some cause a phase displacement between E_1 and E_2 occurs and that E_1 takes a position E_1'. Due to this phase displacement there is a resultant voltage $E_0 = E_1' + E_2$ acting through the series circuit consisting of the two systems. The voltage E_0 causes a current I_0 to flow, which lags E_0 by an angle whose tangent is $\frac{X_1 + X_2}{R_1 + R_2}$ where X is the reactance and R the resistance of the machines plus the line constants. The effect of the circulatory current is to produce demagnetizing action on system No. 1 and increase its load and produce magnetizing action on system No. 2 and decrease its load.

Now consider the case of increasing the generated voltage of system No. 1. E_1' is no longer equal to E_2 and there is a component voltage E_e acting through the series circuit composing the two systems. The voltage E_e causes a current I_e to flow which lags E_e. This current produces demagnetizing action on system No. 1 and magnetizing action on system No. 2 until E_1' and E_2 assume a new phase position such that the action produced by the I_e balances in the two systems. The effect of this circulating current is to lower the excitation voltage of system No. 1 due to armature reaction, since the current is lagging with respect to that system, and raise the voltage of system No. 2, since with respect to that system the current is leading. By changing the excitation voltage the power factor at which each system operates may be altered at will.

Division of wattless component

In a similar manner the division of the wattless kva. carried by the two systems can be controlled by changing taps on the tie-in transformer. For instance, if the transformer is operating on some certain tap and the voltage of the Guanajuato system increases, the Guanajuato system, now having a higher voltage than the transformer secondary, will have a tendency to circulate more wattless current and relieve the Chapala



Arrangement of tap-changing and phase-control mechanism

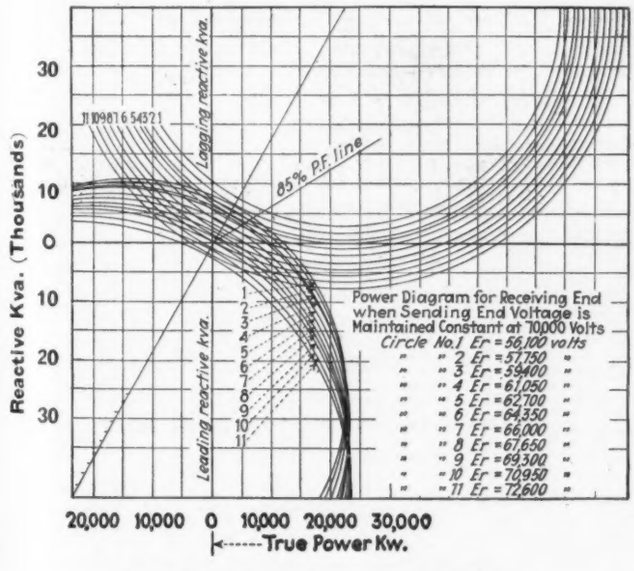
system of some of its reactive load. Now, suppose the taps are changed until the secondary voltage is higher than the voltage of the Guanajuato line, the reverse action will occur. An actual voltage difference will not exist at the point where the two systems are paralleled, since the terminal voltages of the two systems immediately neutralize any difference when paralleled.

Example of power transfer

It is rather difficult to keep a clear picture of the transfer of power and reactive kva. in an interconnected system with varying voltage regulation on the transmission lines. In order to make the picture more clear, the systems can be reduced to a simplified form shown in the illustration. From this is derived a series of circle diagrams* for the system showing the various changes in the sending and receiving end circles with constant sending end voltage and variable receiving end voltage.

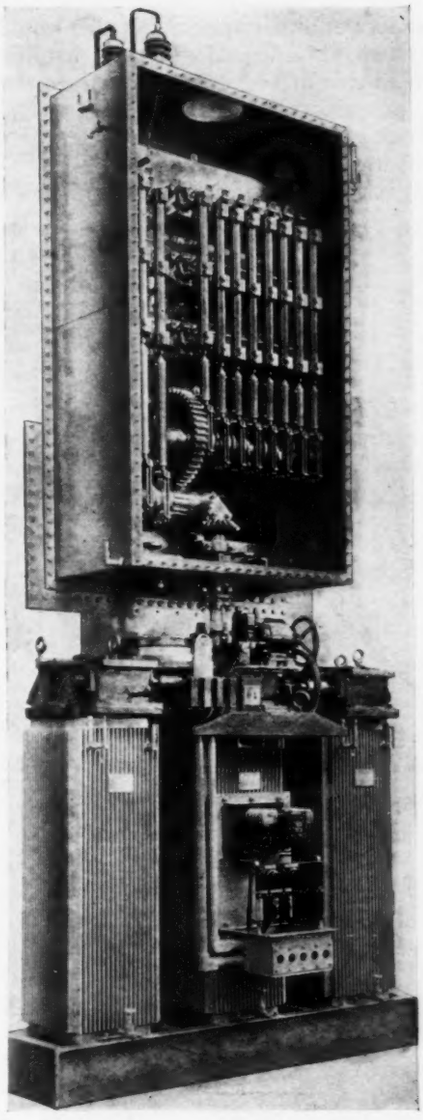
Assume that a load of 5,000 kw. at 85 per cent power factor is to be transmitted from system No. 2 and that the sending end voltage is 70,000 and the voltage of the Guanajuato system No. 1 at the tie-in point is 61,050, the ratio of transformation of the ideal transformer being unity. This condition is exactly represented by circle No. 4, in which the voltage drop due to this load fulfills the receiving and sending end conditions. In other words, with a sending end voltage of 70,000 and a 5,000-kw. load at 85 per cent power factor being transmitted, the voltage drop due to the current in the line will produce a voltage on the secondary of the 1 to 1 ratio transformer of 61,050. Since this is also the voltage of system No. 1, the two voltages are exactly matched. If the voltage of system No. 1 is, say, 62,700 instead of 61,050 volts, a different problem arises if the ratio of transformation of the tie-in transformer is still maintained at unity.

*"Electrical Characteristics of Transmission Circuits," by William Nesbit.


Reactive Kva. (Thousands)
30
20
10
0
10
20
30
11 10 9 8 1 6 5 4 3 2 1
Lagging reactive kva.
85% P.F. line
Leading reactive kva.
Power Diagram for Receiving End when Sending End Voltage is Maintained Constant at 70,000 Volts
Circle No.1 Er = 56,100 volts
" " 2 Er = 57,750 "
" " 3 Er = 59,400 "
" " 4 Er = 61,050 "
" " 5 Er = 62,700 "
" " 6 Er = 64,350 "
" " 7 Er = 66,000 "
" " 8 Er = 67,650 "
" " 9 Er = 69,300 "
" " 10 Er = 70,950 "
" " 11 Er = 72,600 "
20,000 10,000 0 10,000 20,000 30,000
True Power Kw.

Voltage determines power flow at 85 per cent

Constant sending end voltage of 70,000 between conductors with receiving end voltages corresponding to those of the receiving end diagram.



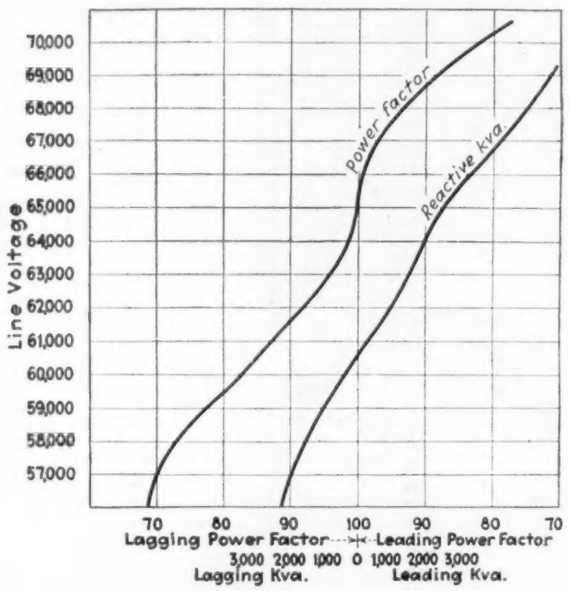
Interconnection tap-changing transformer for 6,850 kva. at Penjamo

Assume that a 5,000-kw. load at 85 per cent power factor must be supplied with the new voltage conditions. An inspection of circle 5, which represents the new conditions, shows that 5,000 kw. at 85 per cent power factor cannot be transmitted within these voltage limits, but that 5,000 kw. with 1,750 kva. leading can be. This is determined from the fact that the point where circle 5 crosses the 5,000-kw. load line does not fall on the 5,000-kw. load line and the 85 per cent power factor intersection. To make the point fall on this intersection it is necessary that the amount of leading kva. represented by the distance measured on the 5,000-kw. load line between circles 5 and 4 be supplied by system No. 2.

By changing taps on the tie-in transformer, the voltages at the tie-in point can be matched under all conditions, thus eliminating the possibility of having to overload either system with reactive kva. in order to meet the voltage difference between the two systems. The same results could be obtained by changing taps on

the step-up transformers of either system, but this would affect any other system or independent loads that are supplied from the high side of the step-up transformers. The voltage of the generators could also be changed to obtain the same results, but this is usually undesirable due to the extensive use of voltage regulators.

The power-factor curve shown is drawn from the



Reactive kva. to maintain voltage

values taken from the receiving end circle diagram for a load of 5,000 kw. and the reactive kva. corresponding to the various receiving end voltage conditions as obtained from the point where each circle cuts the 5,000-kw. load line. It should be noted that at the lower voltages the power factor is lagging, whereas at the higher voltages the power factor is leading. Probably the simplest way of explaining this is that with a certain fixed sending end voltage and receiving end voltage a definite amount of power with a definite amount of reactive kva. can be transmitted. With the lower values of receiving end voltage in order to transmit a certain kilowatt load, it is necessary that lagging kva. be supplied, otherwise the fixed receiving and sending end conditions will not be fulfilled. As the receiving end voltage is increased, the amount of lagging kva. necessary to be transmitted with certain fixed receiving and sending end conditions becomes less and less until a point is reached where leading kva. must be supplied in order to meet the receiving end conditions.

The reactive kva. curve shown on the same figure is drawn for a receiving end load of 5,000 kw. at 85 per cent power factor and indicates the change in reactive kva. that must occur for different receiving end voltages.

Fault analyses

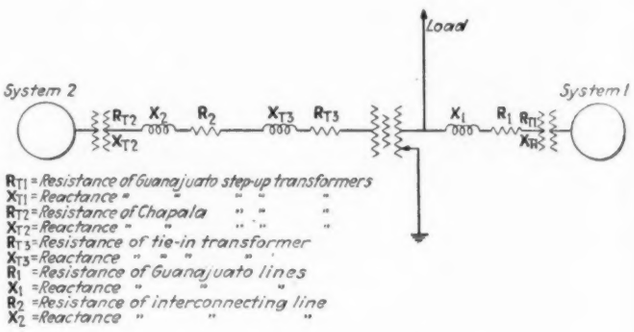
In designing a Y-Y connected transformer for forming a tie between two transmission systems particular attention must be paid to the design of the tertiary winding. The tertiary must be of sufficient capacity, in addition to furnishing excitation for the regulating equipment, to carry any circulating current due to third harmonics and faults. The reactance between primary and tertiary and tertiary and secondary must be of such proportion as to allow the proper amount of ground current to flow in case of a line-to-ground fault to secure correct relay operation.

The delta tertiary provides a path for the flow of the third harmonic component of the magnetizing current, which is a zero sequence current and would, if the delta connection were absent, find a path through the neutral point and the capacity to ground of the transmission line and cause inductive interference.

With a three-winding transformer with neutral grounded, the third harmonic current can flow both through the neutral to ground by way of the external admittance to ground and around the tertiary delta.

The system of the Guanajuato company is grounded at the high-tension side of its three generating station step-up points. The Chapala system is Y-connected but ungrounded at the present time. It is expected that this system will be grounded in the near future. An analysis of the conditions indicates that there is a wide difference in the effect of faults on the delta when the Chapala system is grounded and when ungrounded.

When both systems are grounded and a line-to-ground fault occurs, the paths for the flow of zero sequence current is as shown in the zero sequence network. The point at which the fault occurs is considered to be the source of zero sequence currents. The path for zero sequence currents in the transmission line consists of the three overhead conductors of each line in parallel with a ground return. With a fault occurring at the Penjamo bus as indicated, the delta tertiary plays a very small part in limiting the ground current. This is due to the fact that with both systems grounded, zero sequence current can be induced from primary to secondary, or vice versa, without all having to appear in the delta. The current in the tertiary is caused to flow

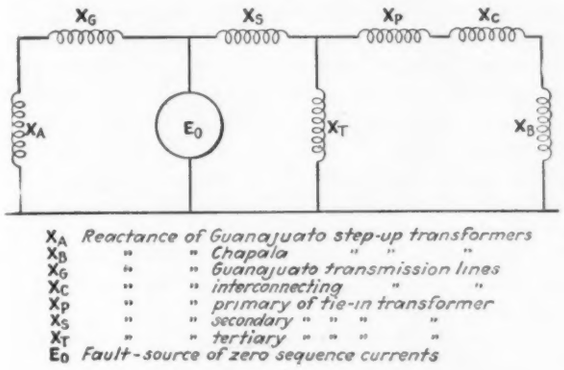

Load
System 2
System 1
R_{T2} X_2 R_2 X_{T3} R_{T3} X_1 R_1 R_{T1}
X_{T2}
X_{T1}
R_{T1} = Resistance of Guanajuato step-up transformers
X_{T1} = Reactance " " " " "
R_{T2} = Resistance of Chapala " " "
X_{T2} = Reactance " " " "
R_{T3} = Resistance of tie-in transformer
X_{T3} = Reactance " " " "
R_1 = Resistance of Guanajuato lines
X_1 = Reactance " " "
R_2 = Resistance of interconnecting line
X_2 = Reactance " " "

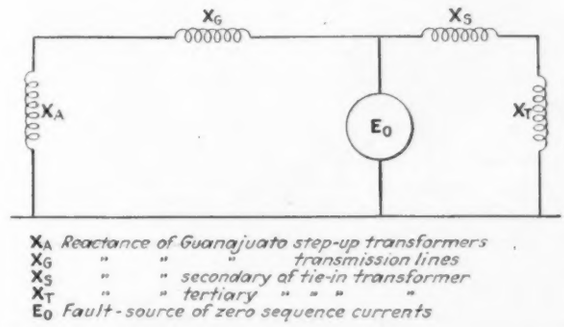
Circuit equivalent to tied-in lines

due to the difference of the ampere turns of the primary and secondary windings.

The Guanajuato system feeds directly to the fault. The Chapala system feeds the fault through two paths, one directly from primary to secondary and the other from tertiary to secondary. It is obvious that if the reactance of the tertiary is high there will be very little circulating current flow in that winding.

When the Chapala system is ungrounded the path for the flow of zero sequence current is as indicated in the diagram. In this case the reactance of the tertiary winding is the limiting factor for the flow of ground current in the transformer neutral. Since the Chapala system is ungrounded, an infinite impedance is offered to the flow of zero sequence current, and as a consequence the Guanajuato system must supply all of the ground current.





Phase sequence with both systems grounded and a line to ground fault, and also with one system ungrounded

The only circuit upon which the fault current flowing in the secondary of the transformer can react is the tertiary, since so far as the primary is concerned only magnetizing current can flow due to the fault current. The amount of ground current in the neutral of the tie-in transformer will depend upon the reactance of the secondary and tertiary windings in series. The tertiary will supply fault current in parallel with the circuit of the Guanajuato system. The zero sequence current flowing in the delta will depend upon the relative impedances of the tertiary and secondary windings with that of the Guanajuato line and upon the distance of the fault from the transformer.

It is evident from the foregoing that unless the transformer is designed with a view to so proportioning the reactances as to allow the proper amount of fault current to flow under various conditions of fault trouble may be encountered in operating the system as far as relaying is concerned. The characteristics of the transmission lines will be a factor which partially determines the characteristics necessary in the transformer.

Trenching Machine Cuts Street-Lighting Costs

By R. J. DRAKE
Assistant Street Lighting Engineer
Public Service Company of Northern Illinois, Chicago, Ill.

CONTRACTING to install an ornamental street-lighting system at $1.25 per front foot for residential streets, $1.50 per front foot for through streets and $7 per front foot for business streets, as was done by the A. A. Electric Company of Chicago in the city of Berwyn, Ill., requires the fastest possible work and the utmost economy in labor if a profit is to be shown on the job. The installation in Berwyn comprised 2,865 units, of which those on the residential and through streets were single post and on the business streets two-light standard in combination with trolley poles.

Realizing that hand labor was out of the question for digging the trenches in which the cable was to be laid, the contractor went one step better than the commonly used method of plowing. He purchased a 16,000-lb. Barber-Greene trenching machine for $5,000. The average man can dig approximately 200 ft. of 24-in. trench

Trenching machine digs 8,000 ft. of 24-in. trench for street-lighting cable

in eight hours by hand. Two men with a plow can open up 4,000 ft. of trench in the same time. But the trenching machine operated by one man can and does dig 8,000 ft. in eight hours. A simple mathematical analysis shows that the machine multiplies the labor capacity of one man by 40. At any reasonable wage scale for common

labor that it is desired to assume it may readily be seen that the machine offers opportunity for very great savings. The ever-present deficiency of all high-priced labor-saving equipment is present in this machine as in all others. That is, the interest charge on the machine during idle periods may readily consume any saving it makes in reduction of labor costs. But there is much street-lighting installation business in the territory of the Public Service Company of Northern Illinois, since the company has for some years past devoted considerable sales attention to this phase of the utility service. The construction field is large but intensely competitive and it is definitely up to any contractor who wants to get in on the money to see that his bids go right down to rock bottom.

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New Basis for Electrical Units

A DEFINITE step toward the adoption of electrical units consistent with those used in mechanics and the establishment of a permanent means of co-ordination between the laboratories which maintain the units in different countries has been made by the International Committee on Weights and Measures. The committee also decided to take up the question of a uniform international unit of light.

In accordance with the recommendations of the Advisory Committee on Electricity the international committee at its regular biennial session held at Paris in June, 1929, minutes of which have recently been released, adopted resolutions translated as follows:

A. With regard to the system of units:

1. Considering the great importance of unifying the systems of electrical measurements on a basis free from all arbitrary characteristics, the absolute system, derived from the c.g.s. system, ought to be substituted for the international units for all scientific and industrial measurements.

2. Since it is not possible at the present time to fix with the exactness which is desirable, and of which they are susceptible, the ratios between the absolute units derived from the c.g.s. system and the international units of current, of electromotive force and of resistance, as these were defined by the International Congress at Chicago in 1893 and the London Conference in 1908, the committee expresses the wish that researches be pursued to this end in the laboratories which are suitably equipped, following a program previously studied in accord with the Advisory Committee on Electricity.

B. The International Bureau of Weights and Measures will establish:

1. An organization to arrange for systematic interchange of standards and to assure the compilation of the results of comparisons made by the national laboratories.

2. A laboratory to which material standards representing the results obtained in different countries can be brought for precise comparisons.

3. A depository for reference standards and working standards, including standards of inductance and capacitance, with the apparatus that is necessary for the comparison of other standards with those of the bureau.

C. The International Committee on Weights and Measures, under the authority given it by the General Conference, will have the responsibility of deciding and of promulgating the values to be employed for the practical standards, and will determine the date of a new revision. To this end, and for the arrangement of experimental determinations and the analyses of their results, the advisory committee will continue to give its counsel to the international committee in the exercise of the functions which the general conference has delegated to the latter committee. The International Committee on Weights and Measures will draw up by-laws to govern the organization and functions of the advisory committee.

D. The International Committee on Weights and Measures will take up with the proper authorities such measures as are necessary to obtain special facilities for the passage across frontiers of packages containing standards, whether accompanied or not.

The by-laws mentioned under paragraph C were also provisionally adopted, but are not to be published until the advisory committee meets again.

Referring to the lack of concordance between the candlepower standards of different countries, the committee adopted the following resolutions:

1. The International Committee on Weights and Measures, considering the importance of unifying the methods used in photometry, decides to study the question of the adoption of an international system of units of light.

2. For this purpose the international committee charges the Advisory Committee on Electricity to advise it on all questions relating to the methods of measurement and to the units and standards of light.

3. The International Committee on Weights and measures authorizes the advisory committee to solicit, for the study of these questions, the collaboration of the International Commission on Illumination.

It was also decided that the advisory committee would be asked to meet again in about a year to consider the question of photometry and the installation of electrical laboratories at the International Bureau of Weights and Measures.

Four Standards of Public Utility Service

IN MY opinion the corporations were organized to give adequate and efficient service. This is the first standard they should meet.

The second standard is that the rates should be as low as is consistent with good service.

The third, that there should be progressive methods, both of operation and rate making.

And the fourth, that there should be publicity in all matters connected with finance and indirectly connected with returns in every way.

DR. ARTHUR T. HADLEY,
Emeritus President of Yale University.

Illinois Governor Says—

The Logical Unit of Utility Regulation Is the State

HON. LOUIS L. EMMERSON, Governor of Illinois, is not in favor of federal regulation of electric utilities. He considers it an intrusion on state authority. He feels that state authority as against federal must be a better regulative agent because it is close to the problem, while the federal government is remote from it. Governor Emmerson says that "Illinois was early in the development of the idea of state regulation of electric utilities. The intelligent administration of state control has been a contributing factor in the wider pervasion of electrical service in Illinois.

"The unit of electric utility control is the state, not the nation. Any form of regulation, whether it is federal, state or municipal, can concern itself legitimately with only two matters affecting electric utility operation. These are adequacy of service and reasonableness of rates. At first—twenty, thirty years ago—electric companies served only comparatively few customers who were all located within the limits of cities and towns. As the operation of the companies definitely involved the public's interest it was correct and proper that municipal government should regulate these operations. But it was not long before electric systems overflowed the limits of cities and towns and brought their services to customers outside of these limits. Also, service was carried to many smaller communities which had neither the precedent for such regulation nor the machinery for its functioning. The interest of large cities, small towns and rural areas required co-ordination into a regulation that would be consistent and not so burdensome on the operating companies as to hamper their development.

"Regulations thus became the logical job of the state government. But federal regulation of electric utilities does not logically follow out of state regulation as state regulation did out of municipal. State regulation became necessary because electric utility operations went outside of the geographical limits of municipal authority into areas in which no regulation existed. There are no such areas outside the limits of a state. If you step over the boundary line of one state your foot comes down in another state. Except the District of Columbia and the territorial possessions there are no areas in the United States that are not under local authority.

"If state regulation of electric utilities functions properly—and I see no reason why it should not; certainly it should always be better than remote federal regulation—there is apparent to me no place for the federal government in the picture."

▼ ▼ ▼

Improving Telephone Service in Lightning Storms

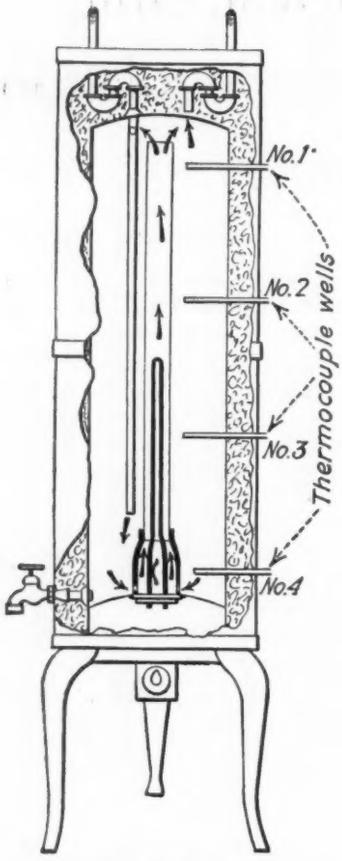
PREVIOUS to the summer of 1928 the Bennington division of the Twin State Gas & Electric Company invariably lost its local exchange telephone service during every thunderstorm or disturbance on its high-tension lines, causing flashovers at its lightning arresters or the opening of high-tension circuit breakers, according to Leon C. White, manager of the Bennington division. Through the co-operation of the local telephone superintendent, it was arranged to have the ground on the telephone protectors removed from the substation and carried out to a distance of about 600 ft. from the plant. This change has resulted in the Bennington division having telephone service through every serious storm and has further aided the telephone company in the prevention of surges into its cable boxes.

Automatic Three-Heat

Field test shows use of 300 kw.-hr. per month for average family and high diversity with 3-kw. heater on 20-gal. tank

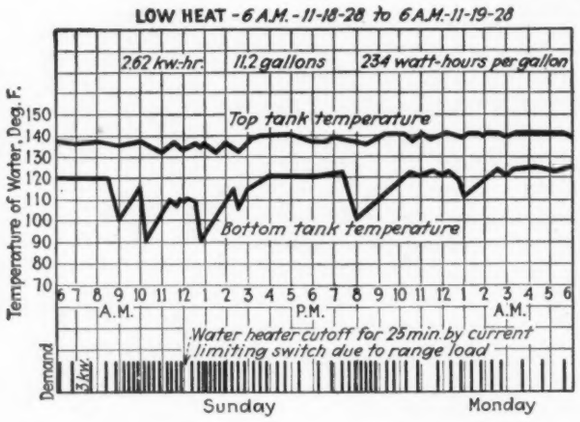
By V. G. VAUGHAN and J. H. REIFENBERG

Manager Appliance Engineering and Appliance Engineer, Respectively, Westinghouse Electric & Manufacturing Company



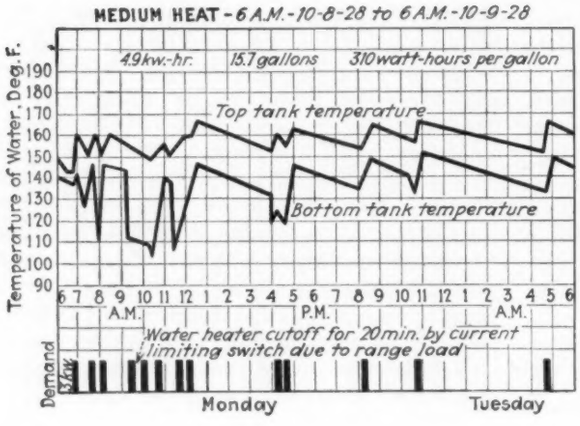
Sectional view of insulated 20-gal. hot water tank

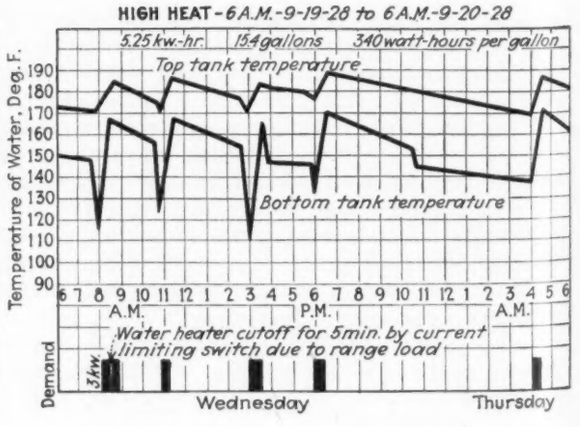
ANALYSIS of a two-and-one-half-month field test last winter of a 20-gal. automatic electric hot water tank insulated with mineral wool and using a 3-kw. triple heat (185 deg. F., 155 deg. F. and 135 deg. F.) immersion heater shows that: (1) The 3-kw. heater can be added to an electric range installation without increasing the fixed charges of the central station;



TEMPERATURE FLUCTUATIONS WITH LOW, MEDIUM AND HIGH HEAT

Typical day charts for each temperature, showing temperature of water at top and bottom of tank, instantaneous demand for hot water, and length of time the 3-kw. heater is energized.





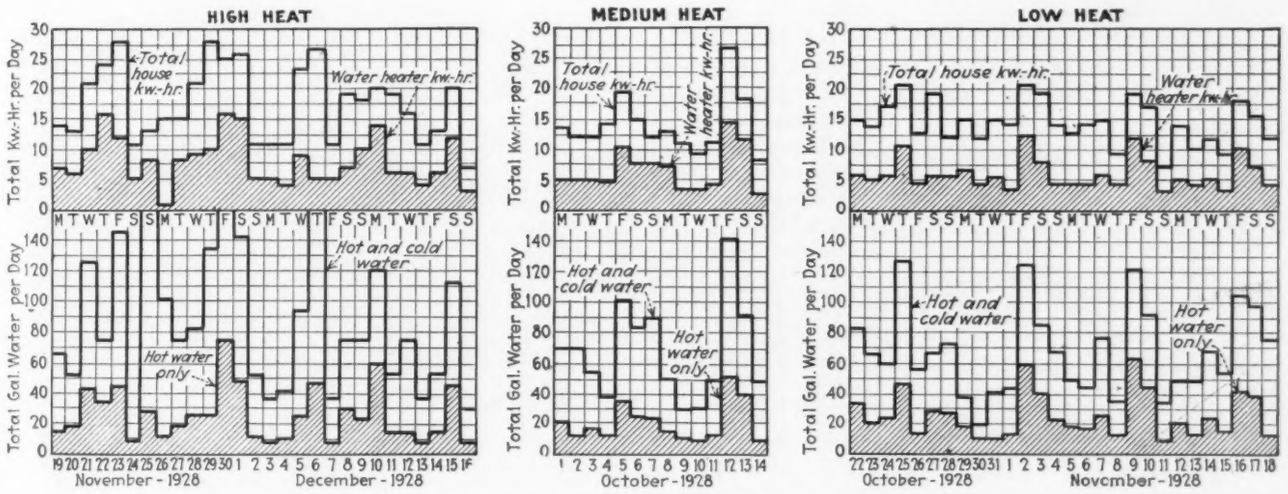
Water-Tank Performance

(2) frequent operation of the heater gives greater diversity; (3) the average kilowatt-hours for electric water heaters need be no greater than 300 kw.-hr. per month for the average family; (4) most families can get sufficient hot water on low heat; (5) operating radiation losses on low heat are as low as 45 kw.-hr. per month, proving that automatic operation is more economical than manual.

Installation of a 3-kw. water heater alone amounts to adding an extra unit to the electric range because of the diversity of operation. A range installation is made on the basis of 8 kw. connected load, 5 kw. average maximum demand and 3½ kw. average demand. Test results show that the range and water heater overlap about 50 times per year maximum and that the average duration of overlapping is ten minutes. The average maximum demand of the electric range and water heater never exceeded the 5 kw. average maximum demand of the range above.

The tank is insulated with 3 in. of mineral wool on the sides and 5 in. on the top. The 3-kw. immersion heater is mounted in the center and four distributed thermocouple wells are welded into the tank for continuous temperature requirements. Hot and cold water pipes enter at the top with circulation traps imbedded in the insulation. Water flow is shown by arrows in the accompanying figure. For laboratory tests the tank was kept at 60 deg. F. in a cold room.

A three-heat switch, Klixon thermostat and thermostat heater form the control elements. On "high heat" the thermostat heater is out of the circuit and the thermostat responds only to water temperature. On "medium heat" part of the current feeding the 3-kw. tank heater passes through the thermostat heater, boosting the temperature at the thermostat above that of the water and causing it to cut off the tank heater sooner than if the thermostat responded only to tank water tempera-



SEASONAL VARIATIONS AFFECT ENERGY USE

Curves show total kilowatt-hours per day for the house, total kilowatt-hours per day for heating water, gallons of hot and cold water per day and gallons of hot water per day for each temperature.

Greater consumption of hot water on "high heat" was due to greater wastage of hot water and because the test was made just before Christmas. Normally, a family requires more hot water at low temperature rather than at high temperatures.

Washdays called for the greatest demand of hot water and the heater was set for "high heat" during the test on these days.

High Heat

Watt-hours per gal. $\frac{234}{730} = 320.5$

Gal. per day per person $= \frac{730}{56} = 13$

Raw water temperature, deg. F. = 48
Softened water temperature, deg. F. = 66
Ratio of cold water to hot = 3.43 to 1
Max. hot water per day, gal. = 74.8
Min. hot water per day, gal. = 7.48
Ave. hot water per day, gal. = 26
Ratio of max. to min. = 10 to 1
Ratio of max. to ave. = 2.9 to 1
Ratio of hot water to total used, per cent = 29.2

Medium Heat

Watt-hours per gal. $\frac{91}{293} = 310$

Gal. per day per person $= \frac{293}{28} = 10.45$

Raw water temperature, deg. F = 52
Softened water temperature, deg. F. = 63
Ratio of cold water to hot = 3.22 to 1
Max. hot water per day, gal. = 51.5
Min. hot water per day, gal. = 9
Ave. hot water per day, gal. = 20.8
Ratio of max. to min. = 5.72 to 1
Ratio of max. to ave. = 2.47 to 1
Ratio of hot water to total used, per cent = 31

Low Heat

Watt-hours per gal. = 234

Gal. per day per person = 12.6

Raw water temperature, deg. F. = 52
Softened water temperature, deg. F. = 63
Ratio of cold water to hot = 2.7 to 1
Max. hot water per day, gal. = 59.1 to 1
Min. hot water per day, gal. = 8.25
Ave. hot water per day, gal. = 25.2
Ratio of max. to min. = 7.2 to 1
Ratio of max. to ave. = 2.34 to 1
Ratio of hot water to total used, per cent = 37

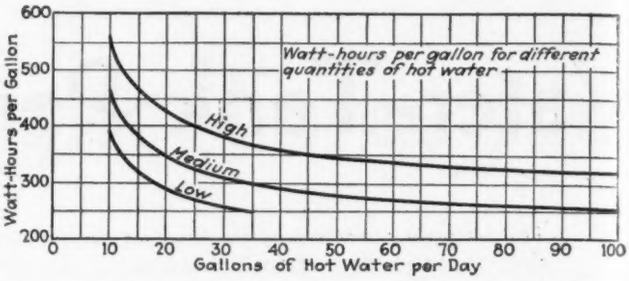
ture. On "low heat" the thermostat heater is in series with the 3-kw. tank heater, greatly biasing the thermostat movement, resulting in a low water temperature. In all temperature positions 3 kw. are used.

When hot water is withdrawn the temperature at the bottom of the tank drops and the thermostat energizes the heater. The rise in the temperature curve indicates the time the heater is on. Three kilowatts are used for "high," "medium" and "low" adjustments, but the length of time the heater is energized varies.

On high heat the average variation of water temperature at the top of the tank is 7½ deg. F. The typical day's chart shows five operations with 15 per cent coming on during the off-peak period (10 a.m. to 6 a.m.). If water is drawn fast enough it is possible to keep the heater on continuously, representing 72 kw.-hr. per day. Idling, the average cycle of operation is "on 25 minutes," "off 23 hours." This is the minimum operation.

On medium heat the temperature is kept within approximately ± 5 deg. F. variation at the top of the tank. The typical chart shows twelve operations with 18 per cent during the off-peak period (10 p.m. to 6 a.m.). Drawing hot water continuously works the heater at its maximum capacity of 57½ kw.-hr. per day. Idling, the average cycle is "eight minutes on," "eight hours off," or a minimum operation of three times a day.

On low heat the temperature is controlled within an approximate ± 2½ deg. F. change at the top of the tank. The typical day's chart shows 57 operations with 22 per cent in the off-peak period (10 p.m. to 6 a.m.). If hot water is withdrawn continuously the heater can only use 7½ kw.-hr. per day. Idling, the average cycle is "1½ minutes on," "1½ hours off." This gives a minimum operation of sixteen times per day.



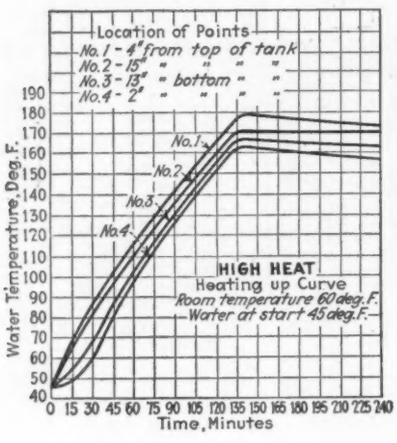
HOT WATER ENERGY REQUIREMENTS

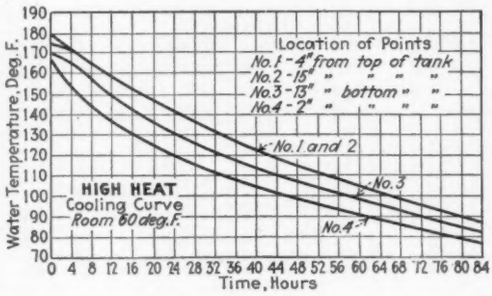
Gal. of Hot Water per Day	10	20	30	40	50	60	70	80	90	100
Stand by kw-hr (water 180° air 60°)	2.71	2.71	2.71	2.71	2.71	2.71	2.71	2.71	2.71	2.71
Kw-hr. to heat water 60° to 180°	2.94	5.87	8.81	11.74	14.68	17.62	20.56	23.50	26.44	29.38
Total kw-hr.	5.65	8.58	11.52	14.45	17.39	20.33	23.27	26.21	29.15	32.09
Stand by kw-hr (water 155° air 60°)	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Kw-hr. to heat water 60° to 155°	2.33	4.65	6.98	9.30	11.63	13.95	16.28	18.61	20.44	23.27
Total kw-hr.	4.63	6.95	9.28	11.60	13.93	16.25	18.58	20.91	23.24	25.57
Stand by kw-hr (water 135° air 60°)	2.03	2.03	2.03							
Kw-hr. to heat water 60° to 135°	1.84	3.67	5.51							
Total kw-hr.	3.87	5.70	7.54							

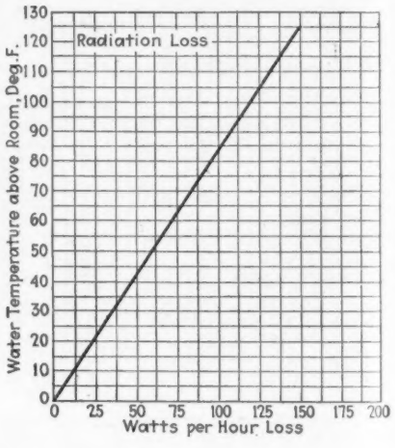
These curves clearly show the value of using the lowest temperature that will give a sufficient supply of hot water and can be used to estimate monthly bill (35 gallons per day is the maximum quantity of water at 135 deg. F. that low heat will furnish, hence the short curve). Watt-hours per gallon based on field test compares with the theoretical figures as follows:

Heat	Temperature, Deg. F.	Theoretical, Watt-Hours	Actual Watt-Hours
High	185	390	320.5
Medium	155	340	310
Low	135	290	234

The following example illustrates the use of this curve for figuring monthly power bill: Take three people at 10 gallons of hot water per person per day or 30 gallons per day (900 gallons per month). From the curve at "high heat" the consumption will be 380 watt-hours per gallon, at "medium heat" 310 watt-hours per gallon, and at "low heat" 260 watt-hours per gallon. The monthly bill at 1½c. per kw.-hr. will be: High, 342 kw.-hr., $5.15 per month; medium, 280 kw.-hr., $4.20 per month; low, 234 kw.-hr., $3.50 per month.


Location of Points
No.1 - 4" from top of tank
No.2 - 15" " " " "
No.3 - 13" " bottom " "
No.4 - 2" " " " "
HIGH HEAT
Heating up Curve
Room temperature 60 deg.F.
Water at start 45 deg.F.
Water Temperature, Deg.F.
Time, Minutes





WATER-HEATER CHARACTERISTICS ANALYZED

Curves show (1) time required to heat full tank of water to 180 deg. F., (2) insulation efficiency of the tank and (3) the theoretical radiation loss of the tank.

The first curve shows it requires 2¼ hours to bring the 20-gal. tank full of 45 deg. F. water up to 180 deg. F. (top of tank) with the "high heat" connection. Four tank temperatures are plotted, there being approximately an 18 deg. F. gradient between the top and the bottom of the tank at the end of the 135 minutes. Total heating up time is not an important factor in automatic hot water tanks.

The cooling curve is a measure of thermal insulation efficiency. At the end of two days hot water (115 deg. F.) was still available and at the end of 3½ days the water in the tank was still 20 deg. F. above the 60 deg. F. room temperature. The cooling curves were obtained by cutting off the heater after the tank had stabilized at "high heat" and allowing it to cool without drawing out water. In this test the heated water was allowed to stand a half day until the water in the top and bottom of the tank was practically the same temperature. Comparative tests should be made on this basis. In actual operation the water in the bottom of the tank may be 30 to 50 deg. F. below that in the top, therefore giving much greater insulation efficiency than shown by this uniform temperature test.

The watts per hour loss varies directly as the water temperature. In this test the wattage input was reduced to a low value and kept constant until the successive readings at twelve-hour intervals showed no change in temperature. Because the tank is at practically uniform temperature throughout, the results will be higher than actual operation, but this method gives more accurate data for comparing different tanks.

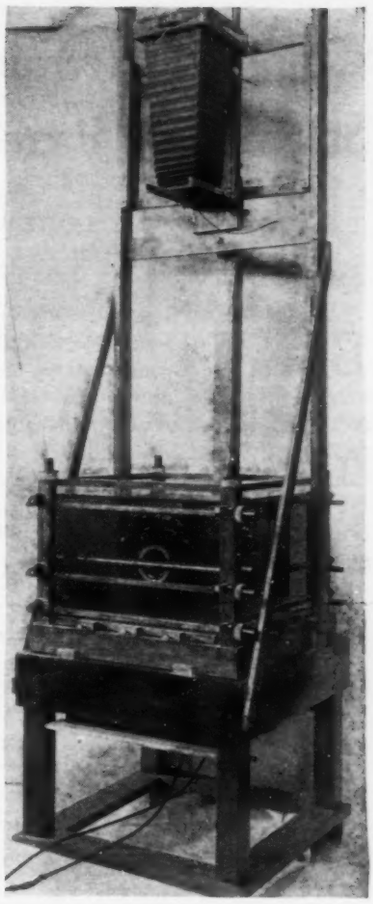
Photography of Dielectric Fields

By L. L. CARTER
Research Assistant Engineering Experiment Station, Purdue University

A NEW plate glass test tank for use in observing and photographing electric fields about insulators and electrical apparatus has been completed and placed in service in the high-voltage laboratory at Purdue University. In this method the test tank is filled half full of high-grade kerosene or eocene, then carbon tetrachloride is allowed to flow into the bottom of the tank, through a tube, until the tank is filled. Very finely cut artificial silk fibers are then sprinkled uniformly over the surface and these sink to the dividing plane between the carbon tetrachloride and eocene, where they float. The insulator, or test specimen, is placed in the liquid in such position that the fibers are in the plane in which it is desired to observe the field and they are allowed time to become perfectly still. The application of voltage will then cause the fibers to arrange themselves in the exact form of the electric field about the test specimen, as the fibers are minute particles of insulation. The field may then be photographed or observed visually.

Electrostatic field about pin type insulator shown by pattern of silk particles

The new test tank is of such size that the fields about the largest pin type insulators now manufactured may be studied. It is so designed that troubles from leaks are minimized and the handling of insulators facilitated. The illuminated bottom of the tank is $26\frac{3}{8}$x$27\frac{3}{8}$ in. and the depth is 20 in. Plate glass $\frac{1}{2}$ in. thick is used for the bottom and sides. All of the joints are ground and there is a $\frac{1}{4}$-in. margin of ground surface around the adjacent edges of all the plates to provide a better holding surface for the celluloid cement used to make the tank liquid proof. Joints at the vertical corners are cut and ground to 45 deg., while the side pieces are set on top the bottom plate. Rubber tape and rubber cement are used between the glass plates, in the joints, to provide a cushion and prevent high spots from carrying too much pressure. It is also expected that the rubber gasket and cement will reduce the loss of liquid if leaks should develop in the liquid proofing cement.



Binary liquid tank for observation of electrostatic fields

The frame is made in such a manner that pressure may be maintained on all the glass joints by tightening the round bakelite nuts on the wooden tie rods. Uniform pressures are maintained by the use of rubber corks under the nuts. The wooden corner posts are free to move in the base and are held against the glass by the rods and nuts. Rubber strips are placed in the wooden frame to cushion the glass. This construction takes all strain off the cemented joints of the tank and the only purpose of the cement is to hold the liquid. The celluloid cement is renewed each time the tank is used and no trouble has been had with leaks of any kind. The only metal used in the frame is in the isolated bolts around the bottom of the tank, and since these do not form a continuous metallic ring and are well below the test plane they do not affect the field.

The tank sets on a rubber cushion in a movable truck which carries the camera mounting and the insulator support. When in use the tank is set on blocks directly under the laboratory hand-operated crane and the insulators and their support are handled with the crane. Light is furnished by a bank of 80 75-watt lamps, placed under the glass bottom of the tank. A ground glass screen is placed between the lights and the tank to provide uniform illumination over the bottom of the tank. This new equipment has performed very satisfactorily.

Graphic Determination of Steam Plant Increment Rates

By RICHARD BROWN
Generating Department
Edison Electric Illuminating Company of Boston

BECAUSE of widespread interest in the interconnection of generating stations and of power systems the need of quickly and accurately determining increment costs has developed. It is possible to build up these costs analytically, but it is also desirable to compare such calculated costs with results actually attained.

Let us compute the increment change in fuel consumption resulting from a change in load on a steam-electric generating station.

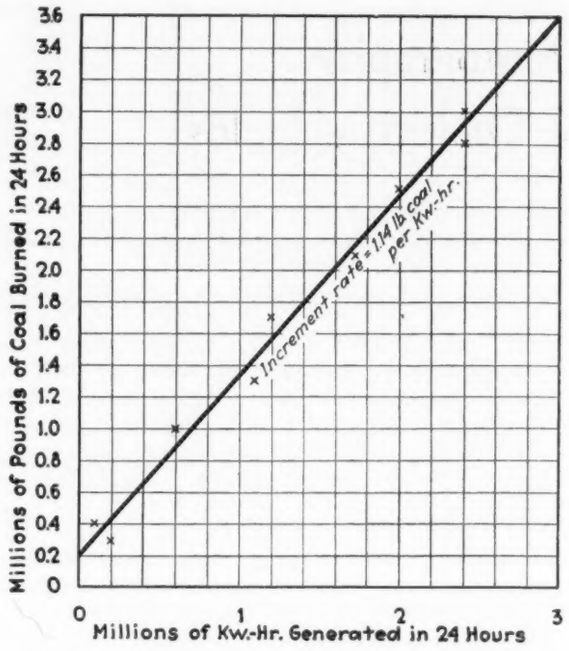
The tabulation below is assumed to represent the performance of an operating plant:

	Millions of Pounds of Coal Consumed	Millions of Kilowatt-Hours Generated
a	0.30	0.20
b	0.40	0.10
c	1.00	0.60
d	1.30	1.10
e	1.70	1.20
f	2.10	1.70
g	2.50	2.00
h	2.80	2.40
i	3.00	2.40
Sum	15.10	11.70
Average	1.68	1.30

It is required to fit a straight line to these points in such a way that it will represent the average of the group more closely than any other straight line. The slope of this line then will be the increment rate of coal consumed per kilowatt-hour generated in the station. A plot of these points and this fitted line is shown in the accompanying illustration. The line passes through the center of gravity of the points, which is 1,680,000 lb. of coal and 1,300,000 kw.-hr. The slope of the line is the sum of the differences of all coal values divided by the sum of the differences of all kilowatt-hour values. These sums could be obtained by subtracting each coal figure from every other coal figure and adding together all of the differences thus obtained. However, with a large number of points this process becomes tedious, so accordingly the following short cut has been developed.

The data are arranged as in the table above so that one of the variables, in this case the coal, is in ascending order. Corresponding kilowatt-hour values are tabulated in the second column opposite the simultaneous coal values. In general the second variable is arranged in ascending order, but the values must be simultaneous. In this case 400,000 lb. of coal is burned when 100,000 kw.-hr. are generated. This point is not in ascending order position, but is correctly placed, in that it corresponds with the proper coal figure.

The formula for computing the sum of the differences is as follows:



Coal increment line for quick reference under varying kw.-hr. outputs

Sum of differences
$= (N-1)a + (N-3)b + (N-5)c + (N-7)d + \ldots$etc.
Where N = number of points.

a, b, c, d, etc., are values in the tabulation as indicated above. In the above tabulation, $N = 9$. The computation of differences follows for both coal and kilowatt-hours.

Coal Differences	Kilowatt-Hour Differences
$8\times0.30 =$ 2.40	$8\times0.20 =$ 1.60
$6\times0.40 =$ 2.40	$6\times0.10 =$ 0.60
$4\times1.00 =$ 4.00	$4\times0.60 =$ 2.40
$2\times1.30 =$ 2.60	$2\times1.10 =$ 2.20
$0\times1.70 =$ 0.00	$0\times1.20 =$ 0.00
Positive sum = 11.40	6.80
$-2\times2.10 =$ — 4.20	$-2\times1.70 =$ — 3.40
$-4\times2.50 =$ —10.00	$-4\times2.00 =$ — 8.00
$-6\times2.80 =$ —16.80	$-6\times2.40 =$ —14.40
$-8\times3.00 =$ —24.00	$-8\times2.40 =$ —19.20
Negative sum = —55.00	—45.00

Net coal differences $= -55.0 + 11.40 = -43.60$
Net kilowatt-hour differences $= -45.0 + 6.80 = -38.20$
Then, increment rate or slope of line
$= 43.6 \div 38.2 = 1.14$ lb./kw.-hr.

A straight line to fit the plotted points will pass through the average point coal = 1.68 kw.-hr. = 1.30 and the point 0 kw.-hr. 0.20 coal. The intercept on the coal axis is calculated by subtracting 1.30×1.14 from 1.68. The equation for this line is therefore

$$\text{Coal} = 200{,}000 + 1.14 \times \text{kw.-hr.}$$

The line was plotted from this equation on the accompanying illustration.

Assuming that these data represent actual station performance, it is obvious that on the average throughout the period over which the data were collected an increase

or decrease in load on this station of 1 kw.-hr. would result in a change in coal consumption of 1.14 lb. of coal. Starting with any load on the station, if it is desired to increase the load 10,000 kw.-hr., it will require 11,400 lb. of coal to do so.

The method is convenient in analyzing costs such as maintenance. In this case total dollars spent on maintenance would be plotted against kilowatt-hours generated, and the computed increment rate would be in dollars per kilowatt-hour.

In applying this method to power plant work it is desirable to plot as many points as possible on account of dispersion. In cases of wide dispersion it is practically impossible to draw a line accurately through a group of points without employing some method of this sort. This method gives results practically identical to those obtained by least squares or moments, but involves much less labor.

▼ ▼ ▼

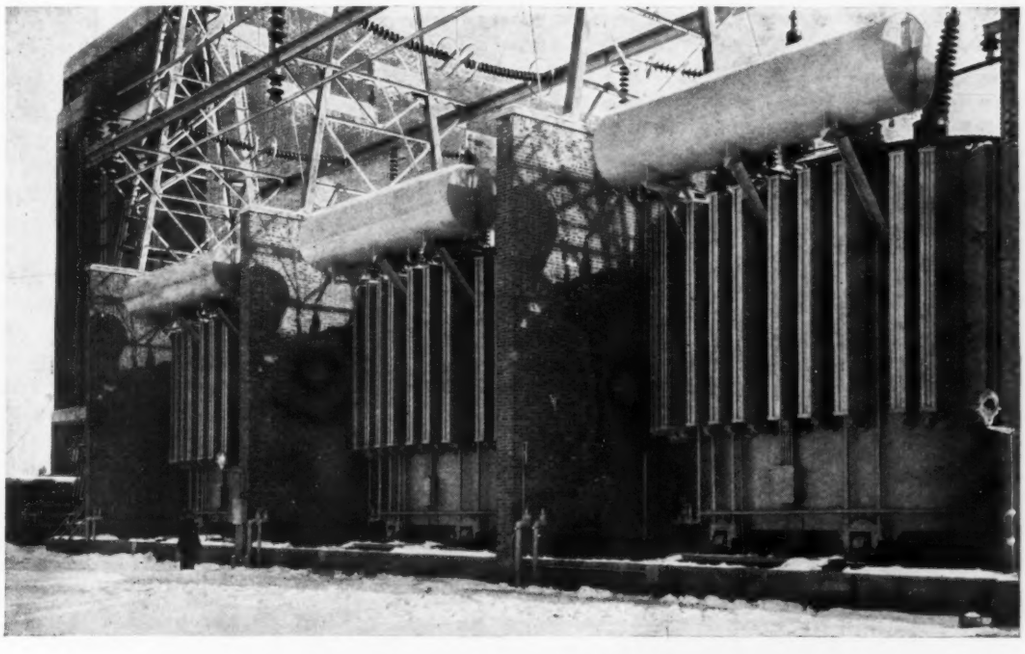
Omits Instrument Transformer Without Impairing Service

BALANCE between equipment indispensable to satisfactory service and that which is often used can be established with resultant economies but unimpaired performance in many cases. During the past few years the Southern California Edison Company has followed the practice of using bushing type current transformers for ammeters, indicating wattmeters and relays in its smaller substations on the 66-kv. network. It was determined that the instrument load was not an appreciable part of the total load and this, coupled with the fact that the reliability and resulting economy over the use of oil-filled or air-insulated current transformers had been proved, led the company to feel justified in adopting the same practice in its large and important 220/66-kv. substations.

At the La Fresa substation, where this practice has reached its ultimate application, the bushing type current transformers have several ratios and are connected to ammeters, the current coil of indicating wattmeters and to the protective relays on each of the 66-kv. circuits. In this set-up it is usually necessary to provide special meters with two current coils which can be connected in series or parallel so that the meter can be given a lower ratio than the relays. Under these conditions instruments may be read with sufficient accuracy for all operating purposes.

Having done away with the necessity of synchronizing by the use of radial type feeders which cannot be energized from another source, instead of loop feeders, and by splitting the bus it is possible to synchronize between sections of bus under any unusual conditions that may arise. This has made possible elimination of potential transformers on individual lines for synchronizing. Potential for directional relays and indicating wattmeters in individual lines is obtained from potential transformers on the main transformer circuit. The only other pur-

TAP CHANGING UNDER LOAD



At the Roseland switching station of Public Service Electric & Gas Company (N. J.) these 220,000-volt tap-changing transformers of Westinghouse manufacture improve interconnection operation by offering full control with flexibility for future system requirements

pose of potential transformers was to give a hot line indication, but it is no longer felt that the extra cost of the potential transformers is justified for this purpose.

Thus, at the La Fresa substation both current and potential transformers have been eliminated from the individual lines, resulting in a saving of approximately $1,500 per circuit in the case of the current transformers and approximately $2,500 per circuit for the potential transformers. With a total saving of $4,000 per circuit, this means a total saving for the ultimate station with 30 circuits of $120,000.

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Hydro-Electric Development in Bombay

By J. T. FERNANDEZ
Hyderabad, Deccan, India

THE water-power undertakings of Messrs. Tatas Sons, Ltd., Bombay, India, intended to supply the city of Bombay and its surroundings are the largest hydro-electric works in India and in some respects the greatest in the world. Bombay is, after London, the most populous city in the British Empire and it is the largest manufacturing town in Asia. At the present time the demand of the mills, tramways and railways, etc., is about two-thirds of the total capacity of the following systems:

Tata Hydro-Electric Supply Company, 70,000 hp.; Andhra Valley Company, 60,000 hp., and the Tata Power Company, 155,000 hp.; a further potential source, called the Konya River project, has lately been investigated and which when carried out will make available a further 80,000 hp.

This triple installation of Tatas, Ltd., is probably unique in the world, inasmuch as the energy is entirely derived from rainfall averaging about 200 in. a year and stored within the catchment areas.

The engineering works connected with the Tata power projects are situated near Lonavla, in the western Ghats of the Bombay Presidency. The rainfall is stored in three lakes at Lonavla, Wlawan and Shirawta, whence it is conveyed in masonry canals to the forebay or receiving reservoir. The power house is at Khopoli, at the foot of the Ghats, whither the stored water is conveyed through pipes, the fall being 1,725 ft. and the pressure 750 lb. The present capacity of the plant installed here is 70,000 hp., but duplication of the pipe line and installation of additional machinery are under way.

To develop the original scheme a northward extension was undertaken called the Andhra River project. A dam about one-third mile long and 192 ft. high was built across it. In this instance the draw-off point is 11 miles upstream of the dam at a level of 112 ft. above the lowest river bed. The water is taken through a tunnel 8,700 ft. long driven in solid trap rock, thence by pipes for a vertical drop of 1,750 ft. to the generating station at Bhivuri, which is about 17 miles from the Khopoli station. This plant is designed to yield 100,000 hp. in its full development, but its present capacity is 60,000 hp.

The latest and most remarkable development is the Tata Power Company's plant, which went into operation last year. This is a southward development of the original scheme and is known as the Nila-Mula project, owing to the fact that the waters of these two rivers were dammed. A 150-ft. dam closes the junction of the two rivers. A 4,000-ft. approach cut and 15,000 ft. of tunnel lead the water to a pipe line descending to a power house containing five 175,000-kw., 11,000-volt generating units driven by double overhung Pelton wheels operating on a static head of 1,640 ft. Four 30,000-kva. transformer banks step the voltage up to 110,000 for transmission over a double tower line to a receiving station at Dharavi, in Bombay, where it is stepped down to 22,000 volts for underground cable distribution in conjunction with the Andhra Valley Company's supply.

The three power schemes are interlinked to assure a constant supply. The total capacity of these three plants is 285,000 hp., of which only two-thirds is utilized, but an increase in load is anticipated owing to the electrification of railways in the presidency. Within the next ten years it is believed that the whole of the surplus will be utilized.

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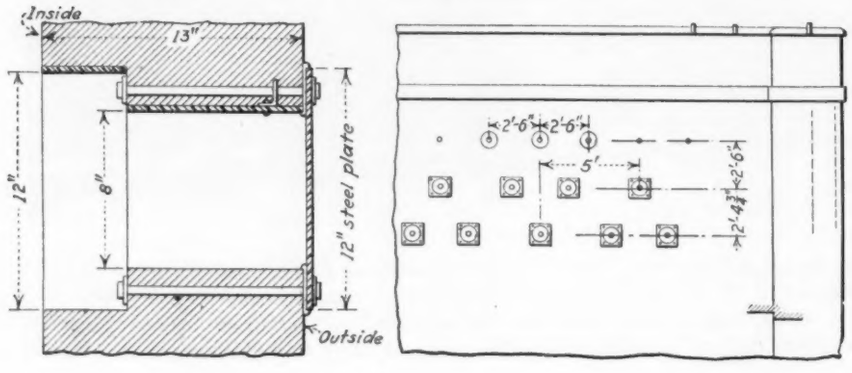
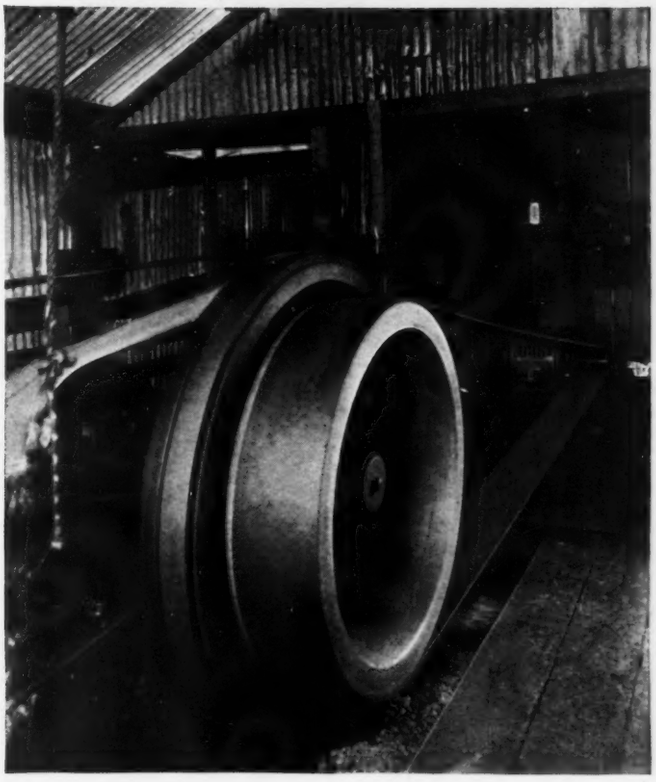
Staggered Bushings Where Space Is Limited



FACED with the problem of providing space for more wall bushings than could be accommodated in a single line along the wall of a substation, one company staggered the position of the bushings as shown.



Converting from steam to electric drive by bolting wood pulley to engine flywheel

LOWERING Oil Well Pumping Investment

By C. C. STEWART

Power Sales Supervisor
Southern California Edison Company,
Los Angeles, Calif.

RAPID decrease in the amount of oil produced in some of the major oil fields of California has necessitated a reduction of operating costs in these fields. The oil operator is turning his attention to bringing about increased efficiency and lower pumping costs by replacing his steam and gas engines with electric motors for pumping.

In the past the oil field pumping equipment consisted of the double-rated oil field motor. This motor was used for pulling the rods and tubing and cleaning out the well, as well as for pumping the oil. In many places the high cost of installing the double-rated motor has resulted in a failure to utilize electrical energy for this purpose since the operating engineer has been informed only of this double-rated oil field motor, and has assumed that he could not afford to pump eleectrically because of the high first cost of the electrical equipment. This limitation, however effective in its past influence, is certainly not an all-important element today.

The high first cost of pumping equipment has now been solved. A small straight induction motor for pumping only is installed. This installation is made in several ways. The gas or steam engine is left in place, the pitman is disconnected from the cross-head, a wood pulley for the belt is then bolted to the side of the flywheel of the gas or steam engine as shown in the accompanying illustration and a 10, 15, 20 or 25-hp. motor is belted to this pulley wheel. By this method the engine is used as a countershaft or speed reducer between the motor and the band wheel of the oil well. In case further speed reduction is necessary, some oil companies have installed an additional countershaft. The motor in this case is belted first to a pulley on this shaft and from here is belted to the gas or steam engine.

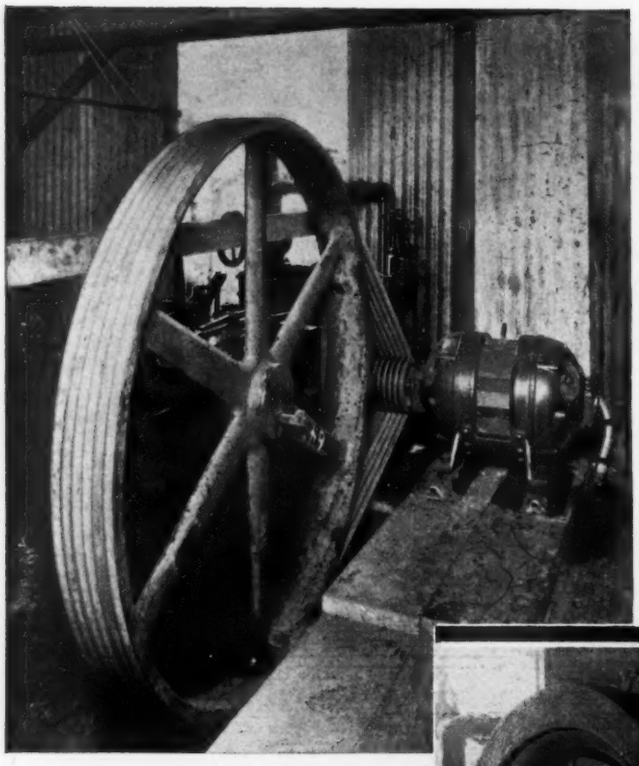
Another method now largely in use is the chain drive. A sprocket is bolted to the side of the engine flywheel and connected to the motor by a roller chain. This has the advantage of a close connection between the motor and the engine and does not require that the engine house be lengthened. A third method which is meeting with favor among oil operators is the V-belt drive. The sheave or pulley is either bolted to or replaces the engine flywheel. The connection from the motor to this sheave is through the Tex-rope or cogbelt drive. This consists of five or more V-belts placed side by side. This

method is quiet, clean, efficient and also has the advantage of a short belt. A typical installation of this kind is shown in an accompanying illustration.

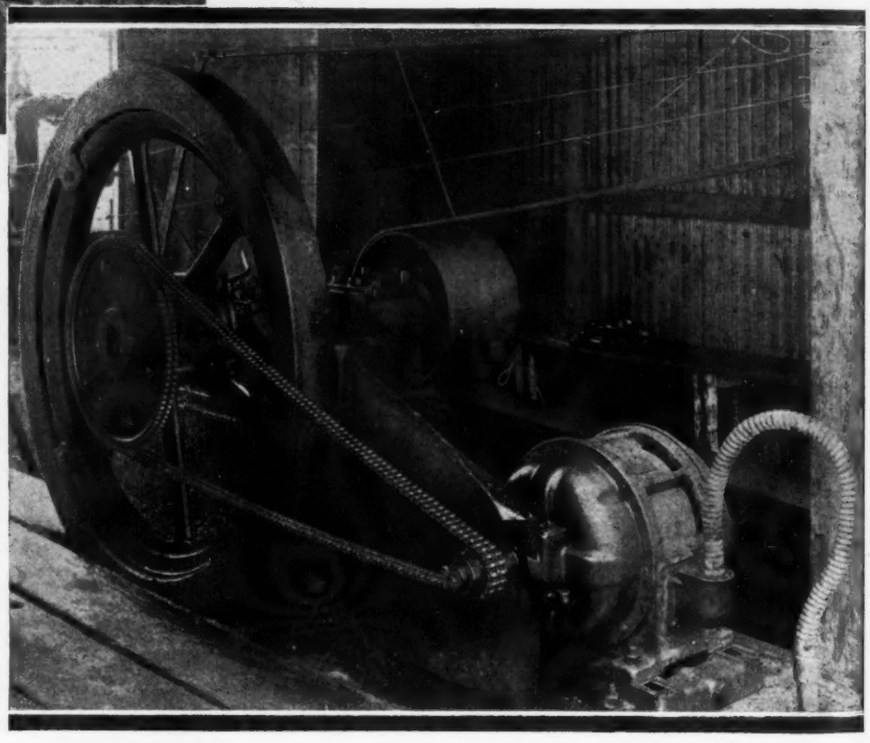
All of the above described methods are used in connection with gas or steam engines. When the rods or tubing are to be pulled the engine is used. These methods are favored by the operator who has only a small number of wells to pump. When used in conjunction with the gas engine, the motor is used for starting the engine, and after the engine is up to speed the belts are thrown off.

The average cost of the complete installation of the several methods described is around $600 per well.

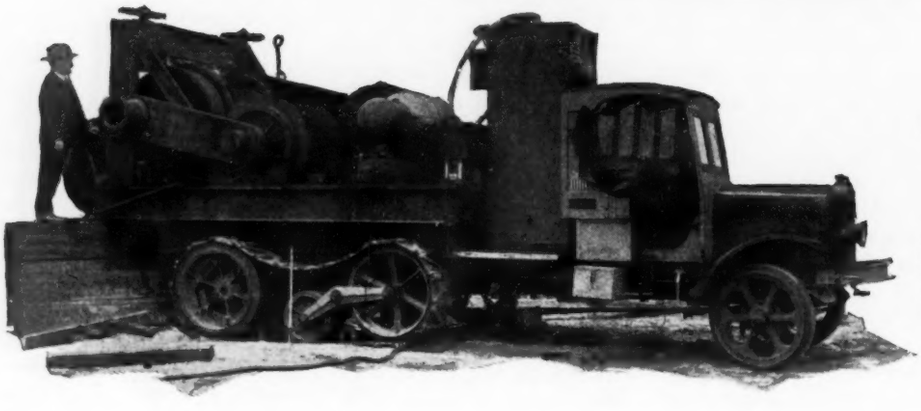
Some of the largest oil operators in California have adopted the small straight induction motor for pumping wells. The motor is used in conjunction with a speed reduction gear set, instead of using the old gas or steam engine for this purpose. This method is used for new installations or where steam is not needed for



Engine flywheel is replaced with pulley or sheave to permit V-belt drive



Sprocket bolted to flywheel permits chain drive



Portable rod and tube pulling outfit

Consisting of 40-hp., 2,200-volt motor with hoist mounted on truck which is used in conjunction with small motor-pumping outfit.

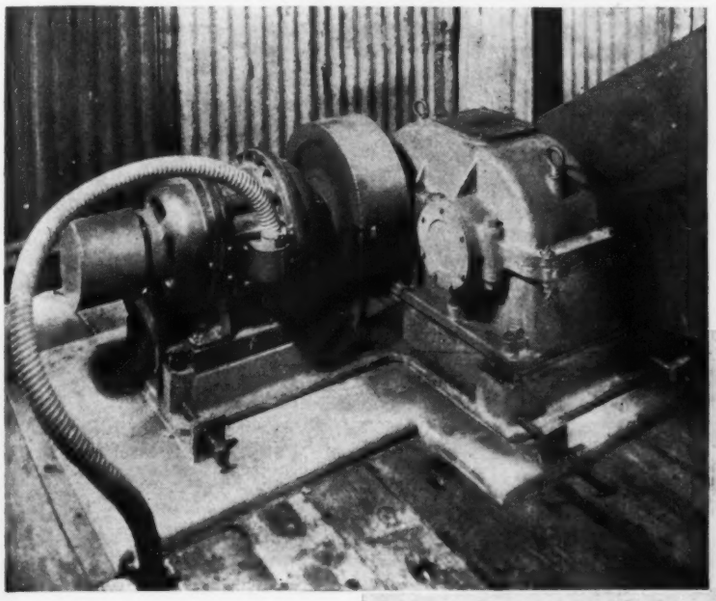
treating the oil. There are several makes of reduction gear units now in use, one of which is shown. A roller chain connects the reduction gear to a sprocket mounted on the band wheel shaft of the oil rig. This type of pumping equipment completely installed costs less than $1,000.

Still another type of drive, known as a direct pumper, consists of a unit reduction gear and crank combined. This reduction gear is driven through a V-belt by a small high-speed squirrel-cage motor.

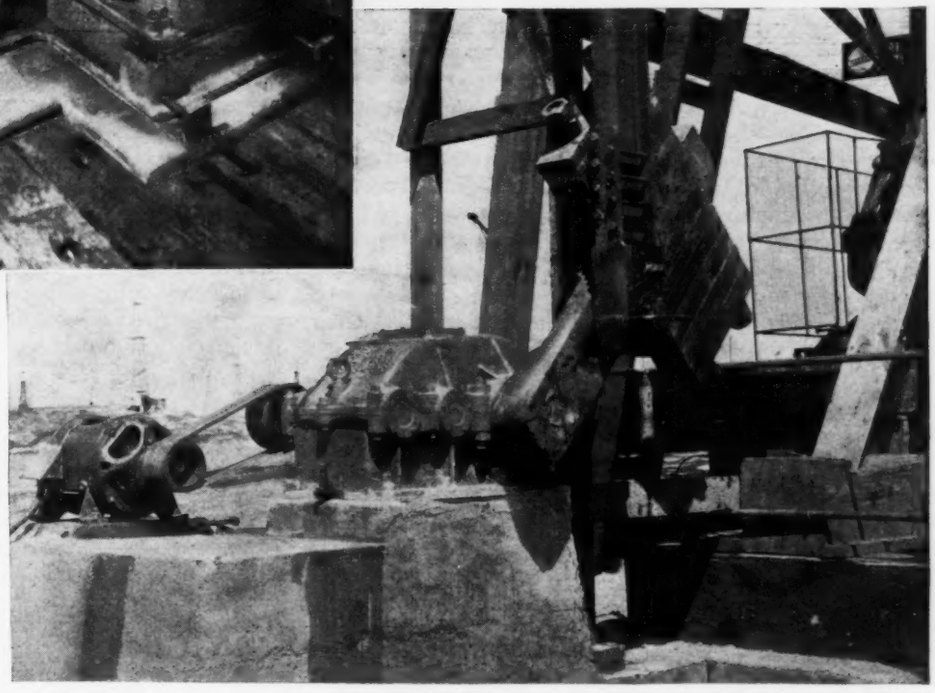
The companies employing such units for pumping use a portable outfit for pulling rods and tubing. This portable pulling outfit, as shown in one of the accompanying illustrations, consists of a standard make hoist unit, mounted on a truck equipped with caterpillar drive. The hoist is driven by a 40-hp., 2,200-volt motor. This equipment is being used for pulling 4,000-ft. wells. For deeper wells a larger motor is necessary.

Those using this method of operation claim many advantages for it over the double-rated motor method. In the first place, 2,200 volts is taken to each well, where it is transformed to 440 volts for the small pumping motor. The 2,200-volt line is taken down the pole at each well to a jack, into which a flexible cable is plugged for connecting the portable pulling outfit. By using 2,200 volts for the pulling motor the need of taking 440 volts to each well for the large pulling motor, which is seldom used, is eliminated. Thus additional transformer and service wire capacity for the pulling motor is not required at each well.

The combined cost of the pumping motor plus the cost of the pulling equipment is much less than the cost of the double-rated motor installed at each well. The cost of the hoist unit mounted on the truck with motor complete, exclusive of the cost of the truck, is around $5,000. The truck shown in the accompanying illustration was an old one not suitable for other use. Oil companies using portable pulling equipment state that it proves economical as against the double-rated motor method where three or more wells are operated.



Speed reduction unit with chain drive to band wheel makes compact installation



A speed-reduction unit connects the motor to the crankshaft in this direct pumper

Oil producers have been quick to recognize the advantages of the small motor to displace the steam or gas engine, even where fuel costs them nothing. In southern California alone some 500 wells have been equipped with small motor drive during the past two years. The electrical manufacturer and the power company also benefit from this replacement program because of the greatly increased number of wells being converted to motor drive due to the reduced first cost of installation as compared with the double-rated motor installation. However, the field still exists for the double-rated motor, since there are many places, especially in hilly and mountainous country leases, where it is impossible to transport the portable equipment for pulling the wells and the old order of things persists.

Contrast Important Factor in Lighting Displays

By M. LUCKIESH
Director Research Laboratory, National Lamp Works, Cleveland

SIZE, contrast, brightness and time of exposure are the four variables which control the visibility of an object. Brightness (the final product of foot-candles) and contrast are generally the two factors which are most directly under the control of the lighting specialist. Of these two, relatively large increases in brightness are necessary to provide conditions equivalent to relatively lesser increases in contrasts.

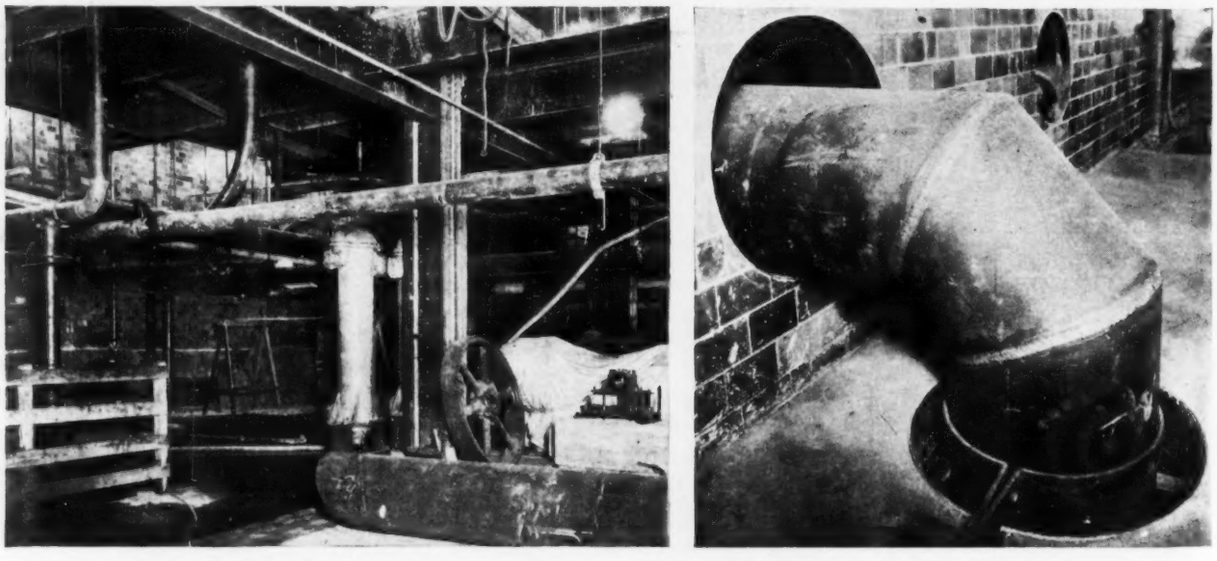
Where the lighting problem is that of making an object most conspicuous or effective from a display viewpoint, we are confronted with conditions considerably different from that of just seeing an object. In displays the size of the object, the contrast between the object and its background, the brightness of the background and the time of exposure are well above the critical values where the object can just be seen. If this were not true the display could not be considered effective. However, just as in the case where visibility is the criterion, the two most controllable factors are brightness and contrast. Of the two, brightness (apparent foot-candles) is mentioned far more frequently than contrast, and from this it is not unreasonable to assume that many lighting specialists consider it more important. Show windows are commonly rated in terms of the amount of light which is flooded on the display.

Of course, a bright window in the midst of average windows possesses more attention value owing to the contrast with the neighboring windows. However, the art of display should not depend solely or primarily upon backward neighbors. While it is difficult to relate all of the factors involved in creating effective displays, we have attempted to relate contrast and brightness, omitting color. From this investigation, involving the choices of 41 individuals, certain contentions have been confirmed and others clarified.

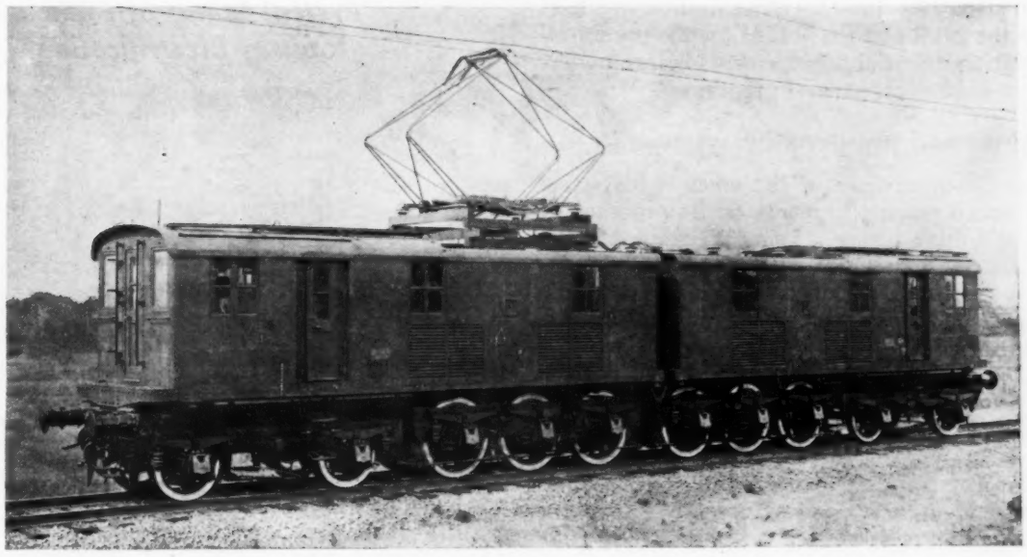
Fifty-four comparisons involving twelve conditions were made by each observer, one pair at a time. The background illumination ranged from 4 ft.-candles to 225 ft.-candles and the contrasts between object and background ranged from 8 per cent to 96 per cent. A perfectly black object on a perfectly white background has a contrast of 100 per cent. The highest intensity of background (225 ft.-candles) ranked tenth in the order of choice when the contrast between the object and its background was 30 per cent. It ranked seventh when the contrast was increased to 69 per cent and only by increasing the contrast to 96 per cent did it assume first place. By maintaining the per cent contrast at 96 the intensity of illumination of the background may fall to 4 ft.-candles and still hold a third-choice position.

While these glimpses into the problem indicate the value of contrast, it is not intended that the importance of intensity of illumination shall be minimized, for at any level of contrast the order of choice appears to be according to intensity of illumination of the background. When the merchandise to be shown provides low contrasts with the desired background, intensity of illumination is the tool we have for creating a condition which will successfully compete with the high-contrast display even though the intensity of illumination which accompanies the display is high.

ELECTRIC WELDING APPLICABLE TO ALL SIZES OF PIPES



Eighty arc-welding machines are used in fabricating virtually all the pipe work installed by the Detroit Edison Company. Here are two samples of pipe welding done by this process which has a wide range of possible use and value in all industries. C. I. Goudey, construction estimator for the company, related in detail the extent to which welding is used in the December 28, 1929, issue of the "Electrical World" and presented unit cost comparisons



1,500-volt locomotive Paris-Orleans Railway

French Railroads Electrify Following National Plan

By DAMON C. WOODS
American Consular Service, Paris, France

ELECTRIFIED portions of the French railways consisted, in 1914, of a few short stretches of the Midi system, the P.L.M. mountain line from St. Gervais to Chamonix, and a Paris suburban line. On September 1, 1929, the total main line electrification had increased over tenfold to 750 miles, including 62 miles of narrow-gage track. The Midi system, traversing the southwestern district of France and drawing hydraulic electric energy from stations in the Pyrenees, leads with 490 miles of electrified standard-gage track. It is followed by the Paris-Orleans, with 145 miles, and the State line, with 35 miles. The Paris-Lyons and Mediterranean has been backward in its program, having only 16 miles of standard and 23 miles of narrow-gage lines electrified.

In 1919 a special commission was named by the Minister of Public Works for the investigation of electrification works in other countries, notably the United States. After completing its inspection trips abroad, the committee agreed that the power best adapted to the French railways would be direct current at 1,500 volts. This conclusion was influenced essentially by the consideration that such a current would allow the connecting up of the railway electric lines with the general electrical system for all of France.

It was therefore decided that the energy conveyed by the primary high-tension lines (three phase, 50 cycles) would be transformed at substations into 1,500 volts, direct current, provided that a tension up to 3,000 volts could be used on aërial lines for special sections where it was deemed advantageous. Although the overhead wires were recommended, except for short distances where numerous tracks or other practical circumstances made the third rail preferable, it was planned to equip the electric locomotives and motor cars with appliances for using both methods of contact.

The Ministry of Public Works approved the report and recommendations of the committee, assuring governmental support of the constructions projected. The entire program called for the electrification, over a period of twenty years, of 5,493 miles of railway lines, exclusive of those in the Paris suburban area. This total was divided almost equally among the three systems nearest the three principal sources of hydraulic energy—the French Alps, the French Pyrenees and the Massif Central, or Central Plateau. The railways and their allotted shares in the program were: The Paris, Lyons and Mediterranean, 1,446 miles; the Midi, 1,959 miles, and the Paris-Orleans, 2,086 miles.

The entire program is expected to cost the equivalent of approximately $200,000,000, divided as follows: $73,200,000 for generating stations and transmission lines, $55,800,000 for contact lines and substations and $72,000,000 for electric locomotives.

It was anticipated that during the twenty-year period of electrification in view an average economy in coal consumption of 3,300,000 tons per year would be effected.

Present state of electrification

According to the Director-General of Railways in the French Ministry of Public Works, the lengths of electrified railway lines, together with the numbers of tractive units thereon, were as shown in the accompanying table in September, 1929. It is thus seen that about one-eighth of the electrification program adopted in 1920 has been accomplished. Difficulties and delays in financing have retarded some of the projects, while the substantial decline in the price of coal, as compared to the prices of the five first post-war years, together with the assurance of an abundant supply from French, German, Saar and English sources, has rendered less urgent the completion

of the entire plan. At present electrification work is proceeding on the Midi and the P.L.M., while the Paris-Orleans is awaiting financial arrangements before undertaking the next stage of its general program.

Progress and prospects by systems

The Midi is far in advance of the other two systems mentioned in actual accomplishments on its program of electrification and this advance is being maintained in the plans under realization. Over 310 miles of lines are now in course of transformation to electric traction. The road from Toulouse to Aix-les-Thermes (76 miles) will be electrified by January 1, 1930; several short lines near the base of the Pyrenees, totaling 93 miles, will be added to the electrified list by the end of 1930, and the 174-mile line from Béziers to Neussargues will be finished in 1931.

Much of the material used in the Midi electrification work is received from Germany on reparations account. It comprises aluminum cables, steel supports, transformers, switchboards, signaling apparatus, electric locomotives, etc. Practically all of the other material and machinery used is of French manufacture. A leading French plant, controlled by the largest American maker of electrical equipment, supplies a considerable number of the machines used in the hydro-electric stations, importing some of them, or parts not made in France, from the parent American concern. The high-tension transmission lines of the Midi are of aluminum, but copper remains the material for the aërial trolley wires.

The Paris-Orleans railway is second in point of electrification, with a total of 145 miles. Aside from its Paris underground tracks, this length relates to the 143 miles of electrified lines between Paris and Vierzon and between Brétigny and Dourdan. The energy is supplied mainly from the hydro stations of Eguzon in the Massif Central and Coindre on the upper Dordogne River; these plants are connected by a 150,000-volt line with the steam station at Gennevilliers, in the Paris suburbs. The substations along the tracks are fed by a double line at 90,000 volts.

In 1928 the consumption of electric energy on the Paris-Orleans, for traction purposes, amounted to 128,000,000 kw.-hr., 60 per cent of which came from hydraulic sources. This consumption resulted in a saving of 242,000 tons of coal. According to a study made in 1928 by M. Parodi, consulting engineer of the Paris-Orleans road, the comparatively level electrified line from Paris to Brive, with its three main tracks, showed a material saving in cost of energy used as compared with the cost of coal, estimating the latter at the 1913 figures of 1,230 tons per mile. With an annual traffic increase of 3.5 per cent, the margin of economy would augment providing the fuel did not appreciably decline in price. The contrary has occurred since 1928, the price of steam coal being now 11 per cent above the figure of a year ago.

M. Parodi found that single-track mountain lines, such as that from Brive to Clermont and from Saint-Sulpice to Montlucon, with a coal consumption of 264 and 220 tons, respectively, could be electrified at an economy over steam power, particularly as the substitution of electric energy would permit an increase of traffic capacity.

The next phase of the Paris-Orleans program is the electrification of the section between Vierzon and Brive, a distance of 186 miles, and this will then be prolonged to Clemont-Ferrand, 62 miles farther. As previously remarked, however, actual work on this project has been suspended until necessary financing can be done.

Present Status of French Railway Electrification

Railway System	Electrified Lines—Miles: Standard Gage	Electrified Lines—Miles: Narrow Gage	Electric Locomotives: Standard Gage	Electric Motor Cars: Standard Gage	Electric Motor Cars: Narrow Gage
State	35	..	39	191	...
Orleans	145	..	219	82	...
P.L.M.	16	37	14	...	157
Midi	490	63	119	43	28
Belts	2	..	...	...	...
Totals	688	100	391	316	185

Third in order of electrification achievements, although not included in the original program of 1920, comes the State (Etat) system, with 35 miles of electrified main track, 39 electric locomotives and 191 electric motor cars. Several years ago the State system began third-rail electrification of some of its Paris suburban lines; those to Bois-Colombes, Saint-Germain, Versailles and Moulineaux have been completed and put into service for passenger traffic. The results have been highly satisfactory, but no further extensions are in course of execution or immediate prospect.

While the P.L.M. has thus far put into service only 16 miles of electrified line, these being in the French Alpine region, it has actively begun electrification of its main line from Culoz to Modane, on the Italian frontier, a distance of 82 miles. This is the first stage of a large program which will ultimately comprise the Lyons-Grenoble, Grenoble-Veynes, Veynes-Marseille and Lyon-Geneva lines, on the one hand, and, on the other, the main line of the Mediterranean littoral, of which the 79-mile section from Carnoules to Vintimille will receive primary attention.

Voter's Attitude Fixes Stock Values

ULTIMATELY the value of public utility stocks depends not upon gross income, but rather upon the rates that the public will allow to be charged.

At present there is no limit in sight to the output in kilowatt-hours. Every present trend indicates that the demand for electric current and gas will continually increase. Given the same rates, this means that the net earnings of the companies would continue to increase likewise. Whether or not these net earnings will proportionately increase depends upon the attitude of the public service commissions; the attitude of these commissions depends, in turn, upon the attitude of the public, namely, the voters.

ROGER W. BABSON.

SALES SENSE

Selling practices to be placed on a scientific and economical basis. Faults and opportunities of industry sales agencies

THE sales problem of the electrical industry is to create a desire for services and products in the minds of customers and then get the goods to the customers in an economical manner. An industry mechanism must be geared to create desire and to secure economical distribution. This is a technical selling problem in the solution of which all branches of the industry are interested—manufacturers, utilities, jobbers, contractors and dealers. All should participate in economical industry selling and all would do well to check up on how well the present conditions are met with existing organizations and practices.

Mistakes of the past

In the past the electrical industry has made several mistakes in selling. Some of these are briefly outlined as follows:

1. A desire for volume of business without a realization of the cost of getting the volume. In many instances sales agencies would have been better off financially if they had given away the product instead of having sold it.

2. Sales by personal contact have been too greatly accented. In the good old days the engineer-salesman needed to sit down with each customer to tell him about the product and its use. Increased sales meant an increased number of salesmen. Today personalized selling should be used only where it is economical. It is not needed to the degree it was in the past and it involves prohibitive costs for selling standardized products.

3. Market knowledge has been absent or has not been applied. Facts and figures are now available for nearly all of the electrical markets and well-founded estimates are available for guides to the future. There is no excuse for selling blindly today.

4. Lack of co-operation and an industry sales policy has handicapped business. Each outlet in each group played a lone hand without co-operation with others. The result has developed a chaotic and uneconomical distribution mechanism. Economical selling means selective selling by the different sales agencies and it means straight line selling whereby each agency devotes itself to the slice of the market in which it can operate to best advantage. Co-operation in creating desire and good faith in sales practices have been absent too frequently.

5. Knowledge has not been applied to get the best results from the tie-in of advertising promotion and sales. Building a desire to buy and supplying the desire requires a co-ordinated sales program with all sales aids focussed on definite objectives.

One by one

These general conditions in industry might well be supplemented by brief outlines of faults in particular sales groups:

Electrical Manufacturers:

1. Too great attention to personalized selling.
2. Too little knowledge of market needs.
3. No application of selective selling by rating and classifying customers.
4. Too great desire for volume with too little knowledge of the cost of getting the fringe business.
5. Too little continuity in sales efforts and too great use of expediency or opportune selling.
6. Inadequate use of advertising, sales and promotional efforts to get a co-ordinated sales result.
7. Lack of co-operation with other sales outlets and lack of study of the market slice the manufacturer can serve most economically.

Public Utilities:

1. Too little knowledge of sales methods and too weak in sales organization.
2. Lack of contact with prospective customers.

IN A SERIES of articles the editors of "Electrical World" will present existing selling practices of manufacturers, jobbers, utilities and dealers and will develop constructive suggestions for improving them through consultation with leading authorities. This series is expected to help the industry expedite its sales program and sell its markets more economically

3. Lack of sales policy and of co-operative plan with other sales agencies.
4. Too little knowledge of sales costs and too great a burden of sales costs on pioneering types of electrical products.
5. Too much tendency to supply a demand that comes without stimulation.

Electrical Jobbers:

1. Lack of knowledge of sales costs.
2. Too much accent on order taking and too little on service.
3. Too many lines handled and too many small customers handled by personalized selling.
4. Too great an extension of credit to customers.
5. Too much price competition and too little business building.
6. Too little co-operation with other sales outlets and inadequate use of sales aids such as advertising, manufacturers' literature and industry advertising.

Contractors and Dealers:

1. Too price-conscious.
2. Competitive bidders and not sellers.
3. Too little cost accounting.
4. Little co-operation with each other and with manufacturers and jobbers.
5. Too little selective selling based on market analysis and knowledge of sales costs.

An educational job

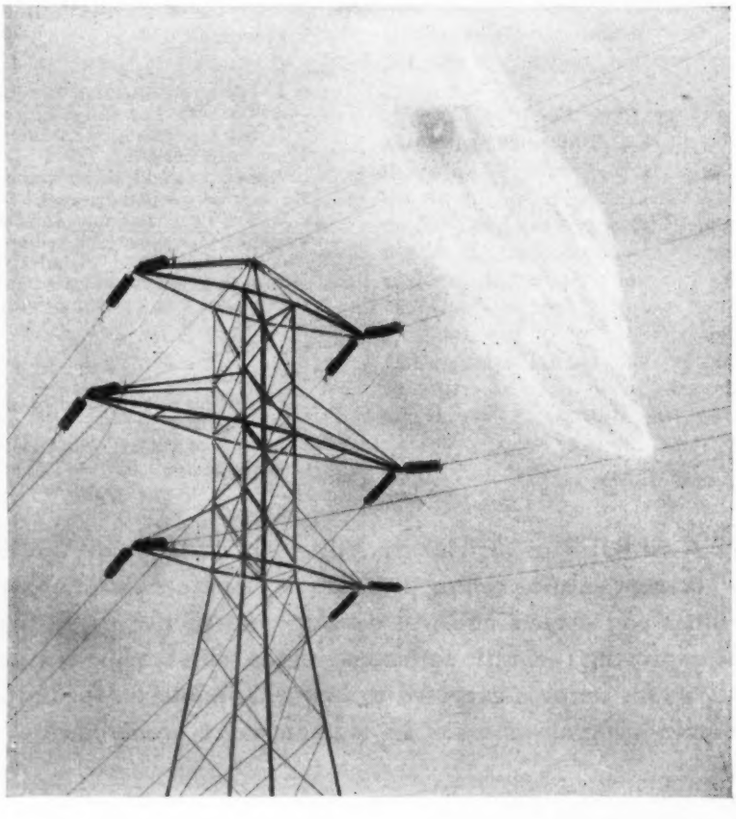
The negatives are mentioned in a constructive spirit and do not include all critical comments by any means. An equally long list of favorable sales factors might also be stated but progress will occur through the elimination of the bad elements, and that is the task of industry sales leaders. The industry has come to see the advantages of correct selling, but knowledge of correct selling is a very recent business achievement. The application of the new knowledge is therefore a matter of time, co-operation and adjustment. Steps are being taken and there is little doubt but that the electrical industry will solve its sales problem promptly and accurately.

The first essential task to develop the electrical market is to create an industry method for building desires in the minds of buyers. Customers must be made happily discontented with what they have and instilled with a desire to use new or more electrical products and services. This must be done in competition with other industries and it must be done through a co-operative movement that is economical. Each sales agency has a job in the creation of desire and in addition there is a national co-operative job to be done.

The second essential is to establish an industry sales policy and to delineate the sales policies and practices of each sales agency in the fields which they can serve most economically. Manufacturers can sell to jobbers and to some large customers, perhaps. Jobbers can sell to dealers and to a selected group of customers and can use service to add to sales. Dealers can allocate to themselves market fields wherein they can serve most profitably to themselves and most economically from the viewpoint of the buyer. Utilities can sell certain products to certain classes of customers most economically. The basic study involves the use of each sales agency to get goods sold in the most economical manner. This requires a knowledge of markets, of sales costs, of services to markets and then the application of the facts to establish sales policies. *Each sales agency must sell to its market. Each sales agency must practice selective selling in its market.*

On top of all this is a tie-in of all sales agencies to develop the national market on a tie-in basis with each local market. There is business for all at a profit. Electrical products and service can compete on an equality basis for the buyer's dollar with other industries. Mixing new knowledge of sales with the desire for more business will bring out a working sales mechanism that meets the needs of the times.

When the Line Flashes Phase-to-Phase



60-cycle flashover on high-tension line sustained under tests

Power Continuity Assured for Tunnel Construction

By F. J. PORTER, JR.
Assistant Power Engineer
New York & Queens Electric Light & Power Company

EVERY precaution and provision to insure continuous, reliable power supply has been taken by the engineers interested in the construction of the new city water tunnel* now being driven through bedrock 500 to 800 ft. below the street level in New York City. A number of shafts are being sunk along the route of the tunnel, boring proceeding each way from them. Electricity produces the necessary compressed air and drives the other machines used in the work. Two large air compressors, a water pump, blower, battery charger and cage hoist are located in each of the sixteen power houses, one at each shaft.

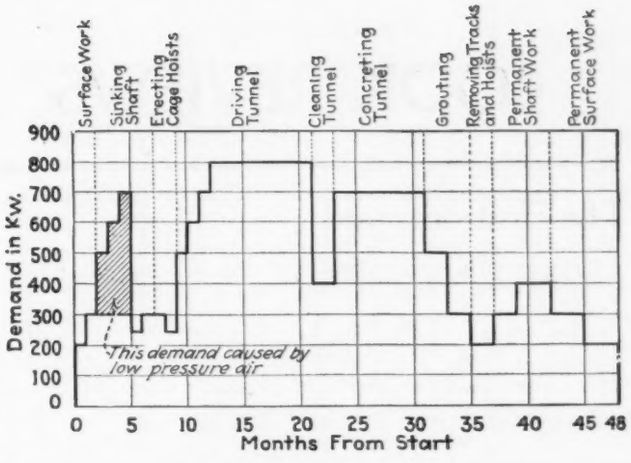
Electric services of 4,000 or 13,200 volts are installed by the local utilities to supply the power houses at each shaft. Where possible, two feeders are installed and where only one feeder is available it is tapped from a loop supply so that energy flow from two directions is possible. Duplicate service is particularly important in Queens and Brooklyn, where low-pressure air for caisson work is necessary during the first six months of the job, and a prolonged interruption of service would endanger the lives of the men working in the caisson.

The incoming feeders pass through the utilities' metering equipment and then to the contractor's main line switches, which are non-automatic. In the case of some of the 4,000-volt services the contractor's equipment is divided and draws energy from either or both feeders, but mechanical interlocks prevent the feeders from being tied together. The switches on the 13,200-volt lines are interlocked mechanically so that energy may be drawn from but one line at a time.

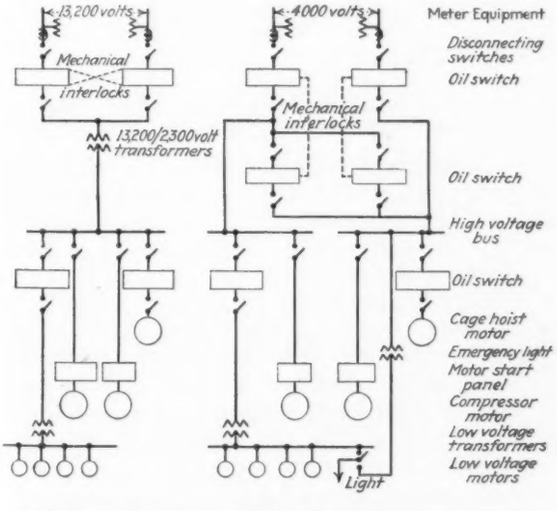
Where 13,200-volt service is supplied three 333-kva. transformers change to 2,300 volts for use on the compressor and cage hoist motors. These transformers are located outside the power house, together with a bank of three 100-kva., 2,300/230/115 transformers for lighting and small motors. In the 4,000-volt power houses the larger motors are run directly at incoming voltage.

The shafts in Brooklyn and Queens will require low-pressure air during the first six months, but will be identical with the other for the remaining 3½ years. The total connected load for all shafts will exceed 15,000 kw. and it is estimated that the consumption will be 8,000,000 kw.-hr. per shaft for the duration of the work.

*"*Mine Hoists in New York,*" R. H. Rogers in* ELECTRICAL WORLD, *August 3, 1929.*



Characteristic load curve for tunnel construction work (contractor's estimate)



Typical power supply layout for tunnel-excavating station

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READERS' FORUM

Line-Type Arresters in Use

To the Editor of the ELECTRICAL WORLD:

On page 299 of the February 8 issue of the ELECTRICAL WORLD appears the statement that "More than 2,500 arrester years of service experience with the old type of autovalve equipment lead to the derivation of this new and improved form." This statement is an inaccurate report of what was said at the convention. As you no doubt know, the experience with the standard autovalve arresters amounts to somewhat over 2,500 arrester years. The figure of 2,500 arrester years applies to the new confined-discharge autovalve arrester announced at the Chicago A.I.E.E. meeting in December and further described at the winter convention in New York. Arresters of this new form have been in the field for over a year. I am taking the liberty of calling your attention to this inaccuracy in your report of the lightning arrester papers, as I am sure that you desire these to be correct.

EDWARD BECK.

Westinghouse Electric & Manufacturing Company,
East Pittsburgh, Pa.

BOOK REVIEWS

The Electromagnet

By Richard Varley and Thomas W. Varley. Englewood, N. J.: Richard Varley. 175 pages, illustrated.

This is a splendid book on direct-current electromagnets. It gives fundamental principles, practical formulas for design, charts and graphs to aid design and complete specifications for many electromagnets. Many curves are given to show what a magnet will actually do and the watts cost to do the work. Wire size, voltage gradient and insulation are discussed and applied to design. In a sense, the book will enable any one to design an electromagnet for any particular application. An interesting part of the book deals with the historical development of the electromagnet, and especially the work of Professor Henry.

* * * *

Electric System Handbook

By C. H. Sanderson, editor-in-chief. New York: McGraw-Hill Book Company, Inc. 1,165 pages, illustrated.

The entire electrical system for the production, transmission and distribution of power is treated in this book. Mr. Sanderson and a group of specialists have arranged the material in logical sequence and the illustrations are splendid presentations of current engineering practice.

The scope of the book includes fundamental units and definitions, generation of power, transmission of power, auxiliary electrical equipment, switchboards, motors, substations, distribution, protective equipment and inspection and maintenance. While written as a practical book, it is thorough in its engineering and definite in its handling of engineering problems. It should be a very valuable book for students and for engineers dealing with light and power systems.

* * * *

Transformer Systems and Their Operation

By W. T. Taylor. London: Charles Griffen & Company. 236 pages, illustrated. Price, $5.

The power and lighting transformer and its application are discussed from a practical standpoint. The transformer and its use after it is manufactured is the key to the treatment. Trends in practice, design aspects for the operator to consider, three-phase systems of transformation, service requirements, transformer substations, transformer protection, phase transformation, operating troubles and grounding are topics discussed in a practical manner. The diagrams and charts are helpful and the book is well written. It would have been better if it had incorporated more about large power transformers, the tap-changing transformer and the phase-shifting transformer.

Design of Electrical Apparatus

By John H. Kuhlmann. New York: John Wiley & Sons, Inc. 445 pages. Price, $6.

This text on design is written for use in colleges. The construction of the apparatus is described, formulas and design procedure are developed, design limits established by practice are outlined and sample calculations are given to illustrate design application. Complete calculations are given for the design of two direct-current machines, two synchronous machines, two induction motors and four transformers.

While largely formulistic in treatment, in the main fundamental reasons are given for design principles and calculations. The arrangement is logical and the book is well written and well illustrated.

* * * *

Einzelbetrieb von Werkzeugmaschinen

By Karl Meller. Leipzig: S. Hirzel. 224 pages, 212 illustrations, twenty tables.

One of a series on electric drive in industry, under the editorship of Prof. Dr.-Ing. E. h. W. Philippi, this volume deals with the application of the motor to individual machine tools in the metal-working industry. The first half of the book, approximately, is devoted to fundamental considerations; e.g., characteristics of the various elements of available electrical equipment and, in particular, economic considerations. It is characteristic of a weakness in industrial data, and probably no fault of the author, that while he can present figures contrasting the cost of group and individual drive, to estimate savings in electrical energy under certain conditions and to give a variety of other interesting data he gives little information as to comparative production per worker. The second half of the book takes up in greater detail the application of motors to particular tools and includes data and curves based on operating tests.

* * * *

St. Lawrence Navigation and Power Project

By H. G. Moulton, C. S. Morgan, A. L. Lee. Washington, D. C.: Brookings Institution. 672 pages. $4.

This institutional survey sets up the arguments for the St. Lawrence project and the sources of opposition to it. It attempts to prove that a 33-ft. channel would be required for the modern type of steam- and motor-driven cargo vessels and more depth for ocean liners, but that 28 ft. would take care of all vessels that would be likely to use the route. The authors, supported by an engineering firm's analysis, are likewise satisfied that the hydro power could not be marketed at New York or Boston, in competition with local steam power, at a price sufficient to cover the cost of its production. The volume will have appeal to those seeking an unimpassioned negative of the enthusiasm for the navigation and power project. An extensive appendix presents the official government interchanges, an analysis of cargo possibilities and a hydro engineering report.

Men of the Industry

J. E. Davidson Selected as "First Citizen of Omaha"

JAMES E. DAVIDSON, president of the Nebraska Power Company and former head of the National Electric Light Association, has had added to the many honors of his career the title of "first citizen of Omaha" for 1929. He was chosen for this distinction by Omaha post of the American Legion and is the

fourth to be so decorated. The legion's selection was indorsed by the Mayor and the newspapers. Mr. Davidson is chairman of the Greater Omaha Association and active in promoting civic movements. He took a leading part in raising $100,000 to stage the Nebraska Diamond Jubilee and Ak-Sar-Ben live stock show, was director of the first community chest drive and was one of a small group that financed the municipal airport.

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Insull Becomes Chairman of Commonwealth Edison

SAMUEL INSULL, who has been president of the Commonwealth Edison Company and the People's Gas Light & Coke Company for a number of years, will become chairman of the board of both these organizations, and SAMUEL INSULL, JR., will become vice-chairman, according to recent reports. EDWARD J. DOYLE will become president of the Commonwealth Edison Company and J. H. GULICK will become chairman of the finance committee. Both Mr. Doyle and Mr. Gulick have been vice-presidents. They, with L. A. Ferguson and J. F. Gilchrist, will become new members of the board of directors of the company.

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J. A. BROOKS has been transferred from the Brooklyn Edison Company to the New York & Queens Electric Light & Power Company and appointed to the position of assistant electrical engineer. Mr. Brooks was graduated from the University of Nebraska and after completing the test course of the General Electric Company he entered the employ of the Brooklyn Edison Company in 1924. Previous to his transfer he was assistant outside plant engineer.

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New Officers Chosen for Nebraska Power Company

ROY PAGE has been elected general manager of the Nebraska Power Company, being promoted from the position of assistant. He will fill the position left vacant some months ago when J. E. Davidson was made president. Mr. Page is a graduate of the University of California and came to the Nebraska Power Company in 1917 as assistant to the vice-president. A year later he was named general superintendent, and in 1922 he became assistant general manager. Mr. Page is a director of the Industrial Development Corporation of Omaha, a civic enterprise devoted to increasing the industrial standing of that city; is chairman of the industrial committee of the Chamber of Commerce and is president of the University Club. He is also president of the Nebraska Section of the National Electric Light Association.

The directors announced at the same time the naming of K. R. MACKINNON and FAY E. SMITH to be assistant general managers. Mr. MacKinnon will be in charge of production, rural electrical development, transportation, stores, purchasing and accident prevention, while Mr. Smith will have general charge of engineering, construction and property records, transmission and distribution, substation maintenance, customers' repair and service departments.

Blackwell Now Vice-President of Columbia G. & E.

HUBERT C. BLACKWELL, president of the Cincinnati Gas & Electric Company and the Union Gas & Electric Company of the same city, has been elected also a vice-president of the Columbia Gas & Electric Corporation, the controlling organization.

Mr. Blackwell removed to Cincin-

nati in 1924 to become vice-president in charge of operations of the Union Gas & Electric Company, succeeding W. W. Freeman as president two years later. Previously he had been vice-president and general manager of the Kansas City Power & Light Company in charge of construction and operations and before that vice-president and general manager of the People's Light Company, Davenport, Iowa. To his long experience as an executive of Middle Western companies have been joined activities in engineering societies and the N. E. L. A. that have brought him national recognition. He was graduated from Purdue University as a mechanical engineer in 1902.

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STUART M. CROCKER, who on January 1 resigned his position as vice-president and treasurer of the United Electric Securities Company to become assistant to the president of the International General Electric Company, has been elected a vice-president

of the latter company, President Clark Minor has announced. Mr. Crocker, a graduate of Harvard University, was assistant to Owen D. Young, chairman of the board of the General Electric Company and Radio Corporation of America previous to his position with the securities company.

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J. H. DRAKE, formerly vice-president and general manager of the Eastern Shore Public Service Company, Salisbury, Md., has assumed similar duties with the Ohio Electric Power Company at Sidney. Mr. Drake had been connected with the Maryland utility for the last two years and was formerly manager of the northern division of the Jersey Central Power & Light Company at Morristown, N. J.

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C. O. WILSON, formerly resident manager of the Utica Gas & Electric Company at Oneida, was recently appointed commercial manager. In this capacity he will direct the activities of the gas sales, lighting sales, power sales, merchandise sales and service departments. Mr. Wilson has been connected with the Utica utility since 1903.

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OBITUARY

Charles T. Hutchinson

CHARLES T. HUTCHINSON, president McGraw-Hill Company of California since November, 1926, died suddenly at his home in Oakland just before midnight on February 12, after a very brief illness. His death thus came as a shock to all his friends and associates and as a totally unexpected loss to the publishing firm with which he had for eight years been connected.

To Mr. Hutchinson's business ability, high standards of dealing and knowledge of the technique of engineering were added sterling personal traits, including a cheerfulness, companionability and never-failing sense of humor which, evinced both in work and at play, gained and kept for him a wide circle of friends.

James H. McGraw, chairman of the board of both the McGraw-Hill Publishing Company and its California subsidiary, said to the ELECTRICAL WORLD:

The measure of any man's contribution to his work lies in the character he has developed rather than in his accomplishment. This has been singularly true in the life of Charles T. Hutchinson. For above all he has been a great personality and a friend to many men. And it was through this gift of friendship that the rich resources of his character and his capacities came to exercise their natural qualities of leadership.

It is an unusual thing for a man to come from one industry and one profession into another and win immediate popularity and influence, yet "Hutch," as all men called him, left the mining field not so many years ago to become editor of a publication in the electrical industry and head of a publishing house. His sincerity, his honesty of purpose, his breadth and depth of vision, his courage and willingness to fight for the right and the progressive, his never-failing whimsical humor, and above all his human understanding and his responsive sympathy, carried him rapidly to acknowledged leadership throughout the Far West. He was

the guide, critic and champion, not of a single group or faction, but of them all, and an inspiration to a practical co-operation among electrical men that was far reaching.

His passing has brought a great sense of personal loss to every man with whom he has been associated—but it is the bond of friendship that will linger longest in our memories.

Mr. Hutchinson was born in San Francisco on January 31, 1876. After completing his schooling in the Polytechnic High School of that city, he went to work in the Union Iron Works there, proceeding from a situation as general office worker, through the accounting department, machine shop and drafting room, to be in succession assistant superintendent, superintendent, sales engineer and manager of the mining machinery department. From 1907 to 1912 he was manager of the mining machinery department of the Joshua Hendy Iron Works, San Francisco. Noteworthy accomplishments as an inventor and a writer in the mining field marked this earlier part of his career.

The post last named he relinquished to engage in editorial and publishing work, being editor of *Western Engineering* from 1912 to 1915, vice-president and general manager Dewey Publishing Company (issuing the journal mentioned and others), from 1915 to 1922, and joining the McGraw-Hill Company of California as vice-president and general manager in the latter year. He was editorial director of the *Journal of Electricity* (now the *Electrical West*) from 1922.

Mr. Hutchinson was a past-president of the San Francisco Electrical Development League, a member of the executive committee of the Pacific Coast Electrical Association and chairman of the California Electrical Bureau. In 1915 he was made a member of the A.S.M.E. board of managers for the International Engineering Congress. He belonged also to a number of social clubs.

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COLONEL JOHN H. FINNEY, for 25 years Southern representative of the Aluminum Company of America, died in Washington January 29. When he left the service of the Aluminum company, at the retirement age, he for a time assisted in the work being done by the Joint Committee of National Utility Associations.

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HARRY L. TANNER, a former resident of Cortland, N. Y., who was president of the Tanner Engineering Company of Long Island City, N. Y., was killed in an automobile accident in Brooklyn on Feb. 11. Mr. Tanner was a graduate of the University of Michigan, class of 1904, and a member of the A.I.E.E.

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CHARLES E. EATON, an engineer with offices in Watertown, N. Y., for 25 years, died at his home in Clayton, N. Y., on February 4. His work included the design of power plants in northern New York, including the Wilder development at South Edwards, the Chasm Falls development at Malone and plants at Higley Falls and Fulton. Mr. Eaton, who was 71 years old, retired from active practice two years ago.

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FREDERICK W. DRURY, vice-president of the Utilities Power & Light Corporation and an official of other public service corporations, died suddenly on February 16 of heart disease at his residence in New York, in his fifty-ninth year. Mr. Drury was vice-president of the Indianapolis Power & Light Company and of the Newport (R. I.) Electric Corporation, as well as a director of the Derby (Conn.) Gas & Electric Corporation and the Eastern New Jersey Power Company. He was born at Alton, Ill., and was a graduate of Yale.

Financial and Statistical News

ALTHOUGH stock financing has not yet commenced to take its place in a large way in the raising of new capital for the utilities except through the issue of rights, certain stock issues are said to be shaping up at present. It is intimated that the market should be receptive to such issues in the relatively near future.

——PESSIMISTIC FORECASTS OF LOWER SECURITIES PRICES in February have failed to counteract gradually returning confidence. Utility common stock prices are well sustained.

Insull Investment Trusts Weather Market Break

THE NET WORTH of Corporation Securities Company of Chicago and Insull Utility Investments, Inc., have shown a steady growth despite the market break. Their value, moreover, is considerably enhanced since the first of the year, according to Samuel Insull.

Dealing with the effect of the market break on Corporation Securities Company, Mr. Insull said:

"The original financing of this corporation was undertaken just prior to the slump in the stock market and was completed about the time that the securities had shrunk most in value. The board of directors decided to make a revaluation of the securities acquired them, based on the price of November 15, which was done, and the balance sheet was accordingly filed with the Chicago Stock Exchange.

"As a matter of fact, although the revaluation was made at about the lowest price the securities sold at during the depreciation in the market, the adjustment did not impair the value of the preferred stock. The total write-off was $34,954,153. Before the write-off the securities were listed at what they had been purchased for, $86,803,103. After the write-offs they were listed at $51,848,950. The net value as of February 15 (including purchases made since December 31, 1929), according to the market price on that date, was $80,732,464, so that, although the board of directors wrote down the original securities slightly under $35,000,000, they recovered upward of $24,000,000. In the publicity originally put out in connection with the offering of the stock the securities were not valued at $86,803,000, but at $80,000,000, so that, as a matter of fact, while on its balance sheet the company is still behind some $6,000,000, on its published statements put out at the time of the organization it is almost even."

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Commonwealth Unit Temporary

THE COMMONWEALTH SOUTHEASTERN CORPORATION, recently organized to acquire control of the Commonwealth Power Corporation and Southeastern Power & Light Corporation, is stated to be a temporary vehicle to permit the merging of the two latter companies, both Maine corporations, into Commonwealth & Southern Corporation under Delaware charter. The Commonwealth Southeastern Corporation will be dissolved after legal and practical details of the merger have been worked out.

Allied Power & Light, Commonwealth Power and Southeastern Power & Light Corporations are to be merged into Commonwealth & Southern Corporation by exchange of preferred and common stock, as previously announced.

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Central Public Service Splits Stock

A FIVE-FOR-ONE-SPLIT and an increase in authorized capital stock from 500,000 to 1,069,230 shares has been voted by the directors of the Central Public Service Company. The directors also adopted a resolution whereby no disposition shall be made of the common stock of the Central Public Service Corporation, which is controlled by the company. The corporation recently arranged to acquire from the Public Utility Holding Corporation a controlling interest in the Portland Electric Power Company.

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Pittsburgh Interests Join United States Electrical Group

THROUGH representation on its board of directors the Koppers interests of Pittsburgh are reported to have become associated with the United States Electric Power Corporation, launched last year by the Harris Forbes-United Founders banking group. It is assumed that this connection involves also the Mellon interests. This establishes what promises to be a new and important alignment of financial interests in the utility field.

Representatives of the Koppers Company who were appointed to the board of directors of the United States Electric Power Corporation are Henry B. Rust, president, and John S. Brookes, Jr., general counsel. Announcement has also been made that the Koppers Company has become one of the largest stockholders in the United States Electric Power Corporation through the transfer of securities and cash. It is stated that a substantial block of class A common stock of the United Light & Power Company is involved.

The Koppers group has been active in the utility field for some time. The company owns directly or indirectly all of the common stock of the Brooklyn Borough Gas Company and working control of the Brooklyn Union Gas Company, while its affiliates control Eastern Gas & Fuel Associates. Koppers Company is also a producer of coal and coal-tar products and is the principal gas engineering organization in the United States.

The new alignment suggests the possibility of co-operation in certain localities with the Standard Gas & Electric properties, control of which recently passed into the hands of the United States Electric Power Corporation. Rumor has again brought American Water Works & Electric Company into the picture in connection with a possible union with the Standard Gas group. It is pointed out that W. C. Langley & Company have large holdings in the American Water Works system and that banking house participated in the launching of United States Electric Power. A leading American Water Works subsidiary, incidentally, serves an area not far removed from Pittsburgh.

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43,700,000 Hp. in Canadian Streams

LATEST FIGURES compiled by the Dominion Water Power and Reclamation Service give the known available water power in Canada, from all sources, as 20,347,400 hp. for conditions of ordinary minimum flow and 33,617,200 hp. ordinarily available for six months of the year. Since analysis of existing plants shows the average installation to be 30 per cent greater than the ordinary six-month-flow power the present recorded water-power resources of the Dominion will permit of a turbine installation of about 43,700,000 hp. The total installation to date in waterwheels and turbines throughout the Dominion is 5,727,162 hp.

The trend of development by central electric station organizations, so marked in recent years, was continued during 1929, as with the exception of the installation of 5,850 hp. by two pulp and paper companies and the replacement of turbines resulting in a net increase of 287 hp. in a knitting mill the entire new installation of 377,930 hp. was installed for public distribution.

At the present time 4,817,486 hp., or 84 per cent, of the total is installed in central electric stations for general distribution for domestic, municipal and commercial use; 578,826 hp., or 10.1 per cent, of the total is installed in the power plants of pulp and paper mills; the industry also purchases some 860,000 hp. from the central electric stations for power purposes, together with a considerable quantity of off-peak power for use in electric boilers; 330,850 hp., or 5 per cent, is installed in industrial and other plants, including those for municipal pumping and electric railway operation.

The total installation for the Dominion now averages 584 hp. per 1,000 of population, a figure which places Canada among the leading countries of the world in per capita use of water power.

Speedy Return on "Peak Load" Data

THE Hartford Electric Light Company's reply was the first one received in the ELECTRICAL WORLD survey of systems having an output of 100,000,000 kw.-hr. in 1929. It came back virtually by return mail, every item carefully filled out. It shows an output 50 per cent greater than in 1928, a gain in one year of 16 per cent in residential consumption, 13 per cent increase per customer, and 22 per cent increase in wholesale energy. The results of the survey will appear in a supplement as soon as they can be compiled.

NEW CAPITAL ISSUES

The Empire Public Service Corporation offers an issue of $3,500,000 twenty-year 6 per cent debentures, series due 1950, and priced at 94½ and interest to yield about 6.50 per cent. Each $1,000 debenture will carry a stock purchase warrant entitling the holder to buy 30 shares of no-par common stock of the Empire Corporation, a holding investment company controlling 96 per cent of the class B stock of the subsidiary, on an increasing scale beginning with $10 up to December, 1932. The Empire Public Service Corporation operates through its subsidiaries a group of electric light and power, telephone, natural gas and water properties in 260 communities in the States of Maryland, Delaware, Virginia, Ohio, North Carolina, Colorado, Oklahoma, Kansas, Arkansas, Louisiana and Texas.

First mortgage and collateral trust sinking fund gold bonds of the Shawinigan Water & Power Company were offered to the amount of $15,000,000 at 98 and accrued interest, yielding over 5.10 per cent. These 5 per cent, series C bonds are secured by direct first mortgage on the company's lands, rights in lands, water powers, dams, power houses and transmission lines owned October 1, 1927, or since acquired and made the basis of an issue of additional bonds, by pledge of certain bonds and by a floating charge on assets.

Central States Power & Light Corporation issued first mortgage and first lien gold bonds to the amount of $3,000,000 at 90 and accrued interest, to yield about 6.30 per cent. These bonds, dated January 1, 1928, mature January 1, 1953.

Canada Increases Output 10 per Cent

THE STEADY RATE of increase in the generation of electricity in Canada is indicated in figures now available showing the output of central electric stations for 1929. The increase in the current generated over the previous year was approximately 1,700,000,000 kw.-hr., or in round figures the same gain as shown in 1928 over 1927.

The total output in 1929 was 17,629,306,000 kw.-hr., including current generated from both water power and fuel. This compares with 15,931,447,000 kw.-hr. in 1928 and 14,231,196,000 kw.-hr. in 1927.

More than 98 per cent of the electric station output was generated from water power, though there was a considerable increase in the amount of power generated from fuel, a growth in this respect being shown from 226,076,000 kw.-hr. in 1928 to 331,459,000 kw.-hr. in 1929. Territorially considered, the central electric stations in Quebec province generated slightly more than 1,000,000,000 kw.-hr. above the 1928 total, the output for 1929 being 8,676,339,000 kw.-hr.; in Ontario there was a gain of approximately 361,000,000 kw.-hr. to a total for 1929 of 6,142,744,000 kw.-hr.; in the prairie provinces a gain of 143,510,000 kw.-hr. to 1,216,415,000 kw.-hr., in the Maritime Provinces an increase of 68,514,000 kw.-hr. to a total of 185,200,000 kw.-hr. and in British Columbia a gain of 17,860,000 kw.-hr. to a total of 1,077,147,000 kw.-hr.

Exports from Canada decreased in 1929, the total being 1,444,402,000 kw.-hr., as against 1,587,757,000 kw.-hr. in 1928 and 1,632,614,000 kw.-hr. in 1927.

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Amicable Agreement Due in Chilean Electric Dispute

AN AMICABLE AGREEMENT is apparently being reached between the Chilean Government and the Compañia Chileña de Electricidad, which is closely associated with the Electric Bond & Share Company, with regard to a draft power contract to which there has been objection in certain quarters. An Electric Bond & Share representative advises the ELECTRICAL WORLD that negotiations are proceeding toward a satisfactory conclusion which will possibly involve concessions on both sides.

The draft contract under which the company was to operate was apparently satisfactory to government technical commissions and was passed by both branches of Congress after a favorable report had been issued by the Director of the Bureau of Electrical Services.

Then came the resignations of the entire staff of that bureau on the grounds that they were not consulted even in technical matters by the director. It was then that certain protests were made against signing the contract.

The power and light company took a conciliatory attitude in addressing an open letter to the press expressing willingness to explain any or all clauses of the proposed contract. It even offered to consider the draft contract void and agreed to draft a new one which would adequately safeguard national interests. Meetings are therefore being held with a view to reaching a basis satisfactory to all concerned.

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Market Half Way Up from November Lows

HOLDING COMPANY STOCKS in the power and light industry have recovered approximately half of their October-November losses. The attached list of representative stocks average 172 at their respective 1929 high points. Their low average for the year was 58. The closing prices on February 13 represented an average of 101, which is less than half way between the high and low marks.

	1929 High	1929 Low	Closing Feb. 13
American & Foreign Power	199	50	97
American Gas & Electric	224	70	138
American Light & Traction	399	190	267
American Water Works	199	50	105
Columbia Gas & Electric	140	52	91
Commonwealth & Southern	24	10	18
Electric Bond & Share	189	50	101
Middle West Utilities	51	18	34
North American Company	186	66	107
Public Service of N. J.	137	54	93
Standard Gas & Electric	243	73	122
United Corporation	75	19	40
Averages	172	58	101

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Building Program Up 10½ per Cent First Quarter

ACCORDING TO INFORMATION received by the National Electric Light Association from companies representing 85 per cent of the light and power industry, the total estimated expenditures for new construction already made, or to be made by March 31, will be $198,000,000. This amount is 10½ per cent higher than the amount expended during the first quarter of 1929. On November 27, 1929, it was estimated that the total expenditures by the light and power companies for new construction, improvement and expansion of their facilities during this year would be $865,000,000, not including expenditures for maintenance of existing facilities. This was 8 per cent higher than similar expenditures during 1929.

The total amount in new orders for equipment and materials with manufacturers and producers already placed, or to be placed by March 31, will be $180,000,000. This is 38½ per cent of the total placements of new orders anticipated for the year. This placement of a relatively high proportion of the year's total new orders in the first quarter gives positive indication of progress in carrying out the 1930 construction program.

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Pacific Company Plans Huge New-Business Program

COMMERCIAL activities of the Southern California Edison Company for the year 1930 will be definitely centered about the task of bringing the total gross revenue to $44,750,000 for the year, as against $40,500,000 for 1929, according to W. L. Frost, general commercial manager.

A total of 365,000 hp. new connected load has been set as a goal. Of this total, 260,000 hp. is to be raised from the sale of power and light by the new-business department; the balance is to be developed by the merchandising department in the sale of appliances.

The 260,000 hp. which the new-business department is to acquire has been segregated as follows: 70,000 hp. lighting load, 35,000 hp. agricultural, 78,000 hp. motor-driven industrial load, 60,000 hp. oil field business and 17,000 hp. for industrial heating. A sales force numbering 50 men will be placed in the field to carry out this new-business program. Of this number, sixteen will devote 100 per cent of their time to the development of lighting business.

In the merchandising field the following quotas have been established: Ranges, 7,500; water heaters, 3,000; refrigerators, 1,500; "red seal" homes, 1,200; washers, 2,000; ironers, 600, and small appliances, 25,000. The merchandising forces will be considerably augmented under the 1930 program, and a new policy under which each specialist will carry on sales work for one specific appliance is to be adopted. A special crew devoted to the sale of refrigerators alone is to be put into the field. Special emphasis is to be placed upon water heater sales, and to carry on this program another specially trained crew of fifteen men is to be put to work. In the heavy-duty and restaurant equipment field there are to be three sales specialists active. Two men to be known as wholesale range specialists are to devote their entire time to the obtaining of range business from apartment house and flat building constructors.

The home service department, made up at the present time of seven women who go directly into the homes of the buyers of electric ranges and teach the theory and practice of electric cooking, is to be augmented by the addition of five new home service representatives, which will bring the total to twelve in the field.

The merchandising activities are expected to obtain 105,000 hp. of new business. Taking into consideration the merchandising profit on the appliances sold, this 105,000 hp. is expected to be obtained at the rate of $2.85 per horsepower total cost to the company. This merchandising activity is expected to bring in, in gross merchandising revenue, the sum of $2,107,500.

To assist carrying through this heavy program of commercial activity, a total advertising expenditure of more than $200,000 is to be made. This will be distributed between the various media, such as newspapers, direct-by-mail advertising, magazines, and miscellaneous forms of advertising. The company will also participate in five of the major county fairs in its territory during the year.

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England's Output of Electricity Gains 21 per Cent

THE RAPID DEVELOPMENT of the supply of electricity throughout England is evidenced by the return of the British Electricity Commissioners for the year ended March 31, 1929, which states that at the end of the year there were 620 undertakings with the number of kilowatt-hours generated amounting to 8,451,400,000, compared with 6,992,300,000 during the previous year, according to a report received in the Department of Commerce from the Office of the Consulate General, London. This is an increase of 21 per cent in a single year. The amount used by consumers for the same years aggregated 7,003,400,000 kw.-hr. and 5,868,100,000 respectively.

The total capital expenditure on the electricity undertakings at the end of 1928-29 was $1,313,950,000, an advance of $146,000,000 during the year.

Business News and Markets

Electrical Manufacturing Operations Decline Slightly

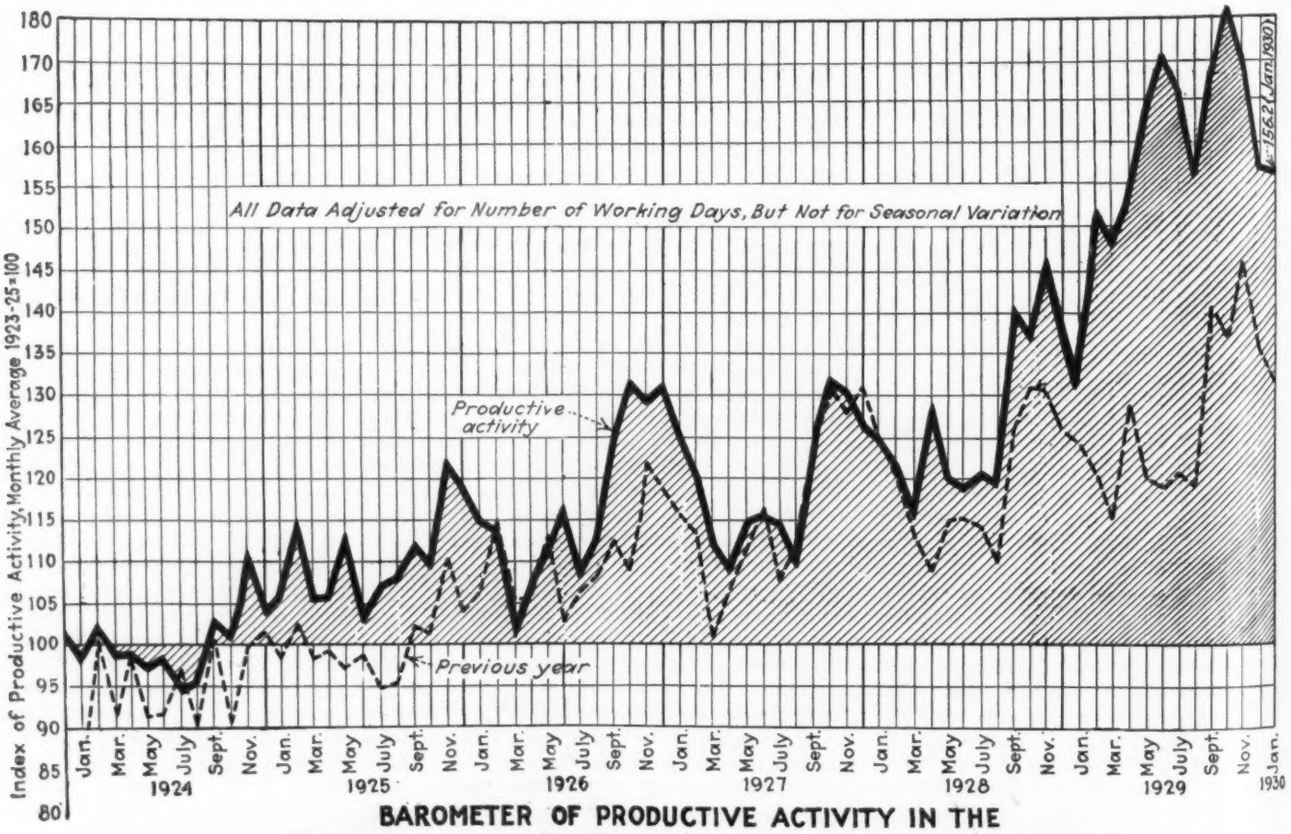
JANUARY witnessed a slight decrease as compared with December in the rate of operations in the electrical manufacturing plants of the country, according to data on electrical energy consumption in these plants as reported to the ELECTRICAL WORLD. This is the third consecutive month in which the rate of operations has declined, but a decreasing rate of productive operations is normal at this season of the year in the electrical manufacturing industry. The January activity, however, was still 19 per cent above January last year. The electrical manufacturing industry is one of the very few industrial groups of the country operating on a higher plane than was reported at this time last year. Past history would indicate, however, that the industry normally decreases operations during February and March, and if this usual trend is followed it is probable that the industry will be operating very close to last year during these two months. It does not appear likely that the abnormal increases recorded during the first six months of last year will be repeated in 1930.

The reports in electrical energy consumption indicate that both the large and small manufacturers witnessed decreased operations during January as compared with December, but only of small proportions. Both groups, however, were still operating on a plane materially above that of January, 1929. The group of larger manufacturers recorded an average decrease in operations during January of 1.2 per cent as compared with December and the group of smaller manufacturers recorded a decrease of about 0.1 per cent. Both groups, therefore, appear to be maintaining a fairly stable position.

January, 1930	156.2
December, 1929	157.0
November, 1929	169.5
October, 1929	180.6
January, 1929	131.3
Average, 1929	159.8
Average, 1928	127.4

The electrical manufacturing industry does not appear to have witnessed the upward trend during January which was reported for manufacturing in general. The electrical manufacturing industry, however, is currently operating on a plane some 19 per cent above this time last year, while the operations of general manufacturing are on a plane 8.1 per cent under January last year. Under these circumstances the fact that the electrical manufacturing plants are maintaining their present level of operations is of large significance for the industry.

The index of activity in the electrical manufacturing industry based on con-



BAROMETER OF PRODUCTIVE ACTIVITY IN THE ELECTRICAL MANUFACTURING PLANTS OF THE UNITED STATES

sumption of electrical energy stands at 156.2 for January, as compared with 131.3 in January last year. Comparative indexes of productive activity for the period 1923-25 as 100 and adjusted for number of working days are shown in the accompanying table.

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Lighting Equipment Plant Goes to Cleveland

IT IS ANNOUNCED that the Westinghouse Electric & Manufacturing Company has chosen Cleveland as the center of production of its industrial and street lighting equipment, as well as floodlights and airport beacons. This division is now in South Bend, Ind. It is understood that C. G. Schluederberg, who has been general manager of the street lighting department, will be in charge.

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Edison Lamp Works Moves

ANNOUNCEMENT IS MADE that the Edison Lamp Works of the General Electric Company is moving its headquarters from Harrison, N. J., to Nela Park, Cleveland, about the first of March. As the National Lamp Works is now located at Nela Park the two lamp selling organizations of the General Electric Company will have headquarters at one point, but will retain separate managements and personnel as at present.

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Justice Department Attacks Fixing of Prices

NUMEROUS COMPLAINTS of price fixing are cited as the occasion for active investigation of trade associations by the Department of Justice. This appears to be the substance of the new anti-trust policy of the administration rather than a general attempt to operate the Sherman and Clayton acts against organized business.

Apparently there was little attention paid to the alleged price-fixing agreements during the period of prosperity. But since business conditions have slowed up somewhat there appears to be much greater interest in such attempts. Attorney-General Mitchell recently explained that when the proposed mergers and other business developments are submitted for advice, it is found that such proposals have sometimes practical elements that are not fully developed when the proposals are submitted "and the transactions seemingly innocuous have in practice worked in apparent violation of the anti-trust laws."

Discussing the situation recently, John Lord O'Brian, senior assistant to the Attorney-General, said: "One of the phases of our work that undoubtedly will be very materially increased is in relation to the activities of the trade associations. They are likely to be the subject of extensive inquiry because of the multiform character of these associations and the great variety of plans under which they operate. Some of those have already been investigated by the department and have been warned as to certain of their practices, and have desisted. Others will undoubtedly refuse to desist and this will mean an increase in the work this year." Mr. O'Brian added that price fixing is the chief abuse and in fact is the only abuse.

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New York Metal Prices

	Feb. 12, 1930 Cents per Pound	Feb. 19, 1930 Cents per Pound
Copper, electrolytic	18	18
Lead, Am. S. & R. price	6.25	6.25
Antimony	8¼	8¼
Nickel, ingot	35	35
Zinc, spots	5.55	5.50
Tin, straits	38¾	39
Aluminum, 99 per cent	24.30	24.30

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Market Conditions

STREET RAILWAY orders feature Eastern business and the outlook in the East is very satisfactory. Volume of sales has not yet increased greatly, but should do so as spring business develops.

——CENTRAL-STATION EQUIPMENT is active in New England.

——DEMAND FOR ELECTRIC EQUIPMENT on the part of manufacturing concerns on the Pacific Coast is substantial this week.

MIDDLE WEST

—SOME SLIGHT ACCELERATION *in general business was noticeable this week in the Middle West section. Considerable seasonal activity is being shown in certain lines of industry and retail trade has improved somewhat.*

—RAILROAD PURCHASING *continues one of the important factors in general business.*

—REPORTED LARGE APPROPRIATIONS *for highway construction work is encouraging.*

Some of the interesting items placed this week include 78,000 ft. one-conductor, No. 0000, 500-volt, 100,000 ft. three-conductor, 375,000 circ.mil, 57,000 ft. one-conductor, 500,000-circ.mil, 17,000 ft. one-conductor, 1,000,000-circ.mil, 110,000 ft. one-conductor, 1,500,000-circ.mil, 183,000 ft. one-conductor, 2,000,000-circ.mil, 500-volt cable; 420,000 ft. four-conductor, No. 0, 278,000 ft. three-conductor, 375,000-circ.mil, 5 kv. cable; 61,000 ft. four-conductor, 375,000-circ.mil, 5-kv. cable; 15,000 ft. one-conductor, No. 6 cable; 55,000 ft. one-conductor, No. 0, 3-kv. cable; 10,000 ft. one-conductor, 400,000-circ.mil, 10-kv., 15,000 ft. one-conductor, 1,750,000-circ.mil, 12-kv., 400,000 ft. three-conductor, 500,000-circ.mil, 54,000 ft. three-conductor, 650,000-circ.mil, 13-kv., 100,000 ft. one-conductor, 750,000-circ.mil, 36,000 ft. one-conductor, 1,000,000-circ.mil, 43 kv. paper and lead insulated cable, turbine parts valued at $23,000,000 and 370 Thompson meters, 10 to 600 amp. capacity.

Jobbers' sales are somewhat slow, though some improvement is noticeable this week. Railroad business continues good, with a slight improvement in industrial activities. Most appliances are moving in fair volume with no outstanding exceptions.

CONSTRUCTION PROJECTS

Elroy, Wis., has authorized installation of additional equipment at municipal electric power plant, including Diesel engine unit. Stoughton, Wis., has plans maturing for an ornamental street-lighting system. Bopp Steel Corporation, Detroit, Mich., has filed plans for plant to cost over $100,000. Public Lighting Commission, Detroit, Mich., plans power substation to cost $125,000. Foote Brothers Gear & Machine Company, Chicago, Ill., plans plant to cost over $300,000. Chicago Bridge & Iron Works, Inc., Chicago, Ill., contemplates extensions and improvements in plant at Birmingham, Ala., reported to cost more than $200,000. Lockwood Manufacturing Company, Cincinnati, Ohio, plans addition

to bakers' equipment manufacturing plant to cost more than $100,000. Procter & Gamble Company, Cincinnati, Ohio, will take bids at once for a plant at Long Beach, Calif., to cost $3,000,000. State Welfare Department, Columbus, Ohio, will soon take bids on revised plans for power plant at state sanitarium at Applecreek, reported to cost about $100,000. Cleveland, Cincinnati, Chicago & St. Louis Railroad, Cincinnati, Ohio, contemplates an engine house and shops at Sharonville, Ohio, to cost about $100,000. Fairmont, Minn., contemplates installation of ornamental lighting system. State Board of Control, Lincoln, Neb., plans power plant to cost about $60,000. Central Power Company, Grand Island, Neb., plans construction of transmission line from Grand Island to Columbus, Neb., to cost about $250,000.

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EASTERN

—TRACTION ACCOUNT *is the center of interest in the New York electrical equipment market, with steam lines, street railways and bus systems all prominent in the demand. The outlook for continuance of buying from this quarter is excellent.*

—A SIZABLE VOLUME *of small orders is assisting both central station and industrial business, with marked tendency for purchasing only for immediate requirements; inquiries show expanding proportions, and more active and sizable demand is anticipated.*

A steam railroad in New York has placed an order with a state manufacturer for insulation materials for $15,000, supplementing a recent commitment totaling $100,000. The Erie Railroad has contracted for four gasoline-electric and one Diesel-electric automatic passenger cars, each with sufficient power to haul trailers. An order has also been placed by the same road for four Diesel-electric tugboats for use in New York Harbor. A leading maker of locomotives reports sales in January as close to six times the volume of the same month last year, with orders for three oil-electric units recorded in 1930. The Gulf, Mobile & Northern Railway Company has inquiries out for two gas-electric railway cars. The Southern Pacific Railway Company has contracted with a Pennsylvania manufacturer for fifteen electric street cars. A traction company in New Jersey has given a commitment to a New York manufacturer for gas-electric drive equipment for 211 buses, the order totaling $300,000.

Marine electric account indicates early promise. Furness, Withy & Company, New York, operating a line between New York and Bermuda, is in the market for a 25,000-ton turbo-electric liner, 575 ft. long and 77 ft. wide. There is early commitment in sight for several electric-operated towboats, averaging about $250,000 each.

A manufacturer of wire and cable says that business is satisfactory, showing up well with account for this time a year ago; there is a good volume of small orders. A maker of switches, cutouts and kindred apparatus is recording excellent sales, with current operations at plant at a high level and every prospect of continuance. A central station in Maryland has placed an order with a Pennsylvania manufacturer for a 30,000-kva. converter unit, with accessories.

A power company in New Jersey has contracted with a New York manufacturer for transformers, switchgear and outdoor switching equipment to an amount of $250,000. A Wisconsin maker has secured an order for a generator unit, with exciter, etc., for a municipal power station installation. A manufacturer of transformers for heavy and light duty says that trade is about normal, with inquiries showing a tendency to lag.

What is said to be the largest order ever placed for electric passenger elevators has been taken by the Otis Elevator Company, covering the installation of 66 such cars in the new Empire State Building, on the site of the former Waldorf-Astoria, totaling $2,900,000.

CONSTRUCTION PROJECTS

Board of Education, New York, will build a boys' vocational school in the Bronx to cost $1,150,000. Theurer Wagon Works, Inc., New York, will establish automobile body and truck plant at North Bergen, N. J., to cost over $300,000. Continental Can Company, New York, will establish a plant at Jacksonville, Fla., to cost more than $100,000. Industrial Institute, Inc., Brooklyn, N. Y., has plans under way for a Diesel engine training school at Toms River, N. J., to cost about $1,000,000. New York Edison Company, New York, is contemplating plans for improvements in Waterside generating station. Board of Education, Newark, N. J., will receive bids until February 27 for a school of fine and industrial arts. Commissioner of Institutions and Agencies, Trenton, N. J., will receive bids on March 5 for equipment for power plant at State Hospital at Hillsdale, N. J. RCA-Victor Company, Camden, N. J., plans extensions in radio and talking machine equipment to cost $7,500,000. Department of Property and Supplies, Harrisburg, Pa., will receive bids until February 28 for electric generator, water heater and other equipment for power plant at Wernersville; also, at same time, for power plant for State Teachers' College, East Stroudsburg. Allegheny Steel Company, Breckenridge, Pa., plans expansion and betterments to cost $500,000. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., will build addition to industrial and street-lighting equipment plant at Cleveland, Ohio, reported to cost over $250,000. Gulf Refining Company, Pittsburgh, Pa., will build an oil storage and distributing plant at Baltimore, Md., to cost $150,000. Davison Chemical Company, Baltimore, Md., has plans for a fertilizer manufacturing plant at Houston, Tex., to cost $700,000. The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until March 4 for one transformer oil-testing set for the New York navy yard (Schedule 2845). Government architect, United States Capitol, Washington, D. C., will receive bids until March 4 for truck-type circuit breakers and other equipment for Capitol power plant, as per specifications on file.

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SOUTHEAST

—BESIDES A SATISFACTORY *volume of small orders, some very interesting large orders were placed last week, the latter coming from Georgia and Tennessee. The industrial field is quiet, few orders of moment being reported.*

A Georgia power company placed orders for four 16,667-kva., four 12,000-kva., four 4,000-kva. and three 833-kva. transformers, besides thirteen 115-kv., 600-amp. oil circuit breakers and some other smaller size breakers, the breaker equipment alone totaling around $300,000. A Tennessee company ordered power transformers costing approximately $100,000 and another company in the same state purchased substation equipment amounting to $50,000. Another interesting central station order was for 80,000 lb. of No. 4 bare copper wire. One company ordered $7,400 in crossarms, while its line hardware purchases in the week aggregated $7,787 and its creosoted pine pole orders $5,065. Some other central station orders were for distribution and small power transformers amounting to $7,488 and small switching equipment costing $3,380. A flour mill moving to North Georgia from East Tennessee placed an order for mill equipment and motors totaling $75,000.

CONSTRUCTION PROJECTS

Winchester, Va., plans floodlighting system and beacon lamps at municipal airport. Berwind-White Coal Mining Company, Philadelphia, Pa., plans installation of equipment at properties at Hartwell, W. Va., to cost over $100,000. Nashville, Tenn., contemplates extensions and improvements in municipal power plant to cost over $80,000. Annette Mining Corporation, Knoxville, Tenn., plans power plant at gold mining properties in Coker Creek district, reported to cost $85,000. Benedict Coal Corporation, Knoxville, Tenn., plans rebuilding of coal tipple and installation of machinery at mines near St. Charles, Va. Ripley Utilities Company, Ripley, Miss., contemplates an ice-manufacturing plant to cost about $40,000. Gulf States Steel Company, Gadsden, Ala., plans steel sheet mill to cost more than $2,000,000. Birmingham, Ala., plans installation of floodlighting system and beacon lamps at municipal airport. Alabama Power Company, Birmingham, Ala., plans transmission line from Gurley to Scottsboro, Ala., and vicinity to cost more than $85,000.

SOUTHWEST

—GENERAL BUSINESS CONDITIONS *in the electrical industry continue satisfactory and at levels well over the same period of last year, the volume of sales to central stations being in the lead.*

—CONTRACTORS ARE STILL BUYING *in good quantity for new work and extension of plants. Several manufacturers are exhibiting electrical accessories at the International Aircraft Exposition now in progress.*

Among the sales reported is an earth induction compass costing about $500. Other contracts are two electric mine locomotives worth $12,000, motors for a rock-crushing plant at $2,000, motor control and electrical equipment for new bottling works costing $10,000 and material for a transmission line in southwest Missouri.

CONSTRUCTION PROJECTS

Mexico Refractories Company, Mexico, Mo., plans firebrick and refractory plant to cost over $100,000. Coca Cola Bottling Company, St. Louis, Mo., has filed plans for a plant to cost $125,000. Warren Cotton Oil Manufacturing Company, Warren, Ark., plans extensions in ice-manufacturing plant to cost $25,000. Paragould, Ark., contemplates a municipal electric light and power plant. Army and Navy General Hospital, Hot Springs National Park, Ark., will receive bids until March 6, for equipment for ice plant and pumping station (Circular 4). Texas Pacific Coal & Oil Company, Breckenridge, Tex., plans gasoline refining plant to cost over $100,000. Amarillo, Tex., contemplates a municipal electric light and power station to cost over $85,000. Baton Rouge, La., plans installation of floodlighting system and beacon lamps at municipal airport. Louisiana Ice & Utilities Company, Bunkie, La., plans extensions and improvements in ice-manufacturing plant to cost about $35,000.

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PACIFIC COAST

—BUSINESS ON THE *Pacific Coast shows indications of expansion. Building is proceeding at a satisfactory rate.*

—INDUSTRIAL AND CONSTRUCTION *business has featured the past week, particularly in lighting equipment for factories and municipalities.*

A can factory bought $2,000 worth of reflectors and wiring material, an oil company $20,000 worth of station sign lights, a paper company $5,000 worth of office building fixtures and a printing plant purchased fixtures and wiring material amounting to $1,500. Street-lighting business is especially good, with such awards as $84,000 for 306 standards for Los Angeles and another award of $22,000 for the same city, as well as 120 standards for San Clemente and 63 standards for Pacific Grove. Additional projects include $20,000 worth of equipment for San Francisco, $15,000 for Fresno, $10,000 for Redwood City and a $19,000 job for Hanford. Installations for Modesta, Santa Cruz, Tracy and Gustine are proposed. Southern California reports proposed extensions for Long Beach and Anaheim, a survey for an extensive system in San Diego and a $15,000 sale of Westinghouse tops for a Los Angeles suburb.

Major construction includes many hospitals, such as for Palo Alto, Eureka and the U. S. Marine Hospital at San Francisco, and a $500,000 remodel job at Bakersfield. Another large government job to be let during February covers 10 miles of 7,000-volt line for a naval dump in Nevada, including such items as a car of 3½-in. fiber conduit and 15,000 ft. of No. 4, 2,500-volt park cable.

Power company business includes a carload of 4-in. fiber conduit, four assorted carloads of poles and two carloads of pole line hardware, three 2,000-kva. transformers valued at $25,000 for Portland and $15,000 worth of Westinghouse high-tension insulators for Los Angeles. Westinghouse also reports the sale of $50,000 worth of ranges for Los Angeles distribution and $75,000 to Butte, Mont., record orders of their kind in Western territory. Railroad business includes a carload of strand and $50,000 worth of signals for Sacramento Valley.

The city of Tacoma awarded a contract for furnishing one 27,777 turbo-generator set for a $2,000,000 steam auxiliary to the General Electric Company for $366,000 and for an 18,200-sq.ft. condenser to C. C. Moore & Company, Seattle, for $63,020.

Pacific Power & Light Company started surveys for a projected 110,000-volt transmission line to link the Northwestern Electric Power plant at White Salmon with the plant in Yakima, for which sum in excess of $1,000,000 has been budgeted. The city of Seattle bought 200 30-amp. type R multiple street circuit relays for $2,137, 2,500 light reflectors for $3.95 each and 27 indoor and outdoor induction voltage regulators, the latter from Westinghouse, for $45,074. Seattle opened bids for 250 cedar poles ranging from 40 to 90 ft. for distribution line replacements.

CONSTRUCTION PROJECTS

Los Angeles, Long Beach, Santa Cruz, Palo Alto, Pomona and Fortuna, Calif., plan ornamental lighting systems. Firestone Tire & Rubber Company, Akron, Ohio, plans factory branch and distributing plant at Stockton, Calif., to cost about $200,000. Beaver Portland Cement Company, Portland, Ore., contemplates hydro-electric power plant at Gold Hill, Ore., for cement mill service to cost about $275,000. Portland Electric Power Company, Portland, Ore., has plans for an addition to steam-operated electric power plant on East Lincoln Street to cost about $100,000. Washington Water Power Company, Spokane, Wash., and Northwestern Electric Company, Portland, Ore., plan joint construction of steel tower transmission line from White Salmon to Yakima, Wash., about 80 miles, to cost close to $1,000,000. Tacoma, Wash., plans early call for bids for cables, switching equipment, traveling crane and other electric station equipment. Idaho Falls, Idaho, plans installation of additional generating unit and auxiliary equipment in municipal power plant No. 2, on Snake River, reported to cost close to $100,000. Utah Oil Refining Company, Salt Lake City, Utah, plans extensions in plant to cost $150,000. Tucson, Ariz., will soon take bids for airport lighting equipment.

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NEW ENGLAND

—SALES ARE STEADY. *Industrial equipment is becoming active. Power apparatus is in good demand and central-station equipment is being quoted on for a number of interesting projects.*

—RECENTLY ORDERS *for power motors and control equipment were placed for a number of mill and factory additions.*

Turbo-generators are again forging ahead in interest and an order for two small units amounting to over $25,000 with accessories was recently reported. Small motors are steady and sales are above the level reported for last year. During the past week a number of orders for fractional-horsepower motors were noted. Power equipment for large heavy rolling equipment for textiles and paper mills is attracting attention. Central-station sales this month are very encouraging and quotations are being asked on pole line materials.

Inquiries for transformers are more active than at this time last year. Scheduled materials are active and some specialties are gaining in volume over the demand last year, among which should be noted marine electric control equipment, arc-welding units and domestic electric ranges. Service expansion is projected on an encouraging scale for western Massachusetts. Substation projects are being planned which include new stations for an Eastern utility, a western Massachusetts company and others. Merchandising shows an encouraging trend.

CONSTRUCTION PROJECTS

Worcester Suburban Electric Company, Uxbridge, Mass., will build a power substation at Douglas, Mass., reported to cost $50,000. New Bedford, Mass., plans a vocational school for girls to cost $225,000. United Shank & Findings Company, Whitman, Mass., plans shoe factory at Savannah, Ga., to cost $100,000. Wilcox & Crittenden Company, Hartford, Conn., has filed plans for foundry addition at marine hardware plant to cost about $100,000.

New Equipment Available

10,000-Lb.-Strength Bus Supports

AN IMPROVED LINE of bus supports with cantilever strengths up to 10,000 lb. is announced by the Champion Switch Company, Kenova, W. Va.

This high strength has been secured

by improved distribution of stresses and a method of anchoring the metal parts in each end of the porcelain unit. The porcelain units are made in several diameters and heights, the fittings for all types and sizes of conductors. The supporting base is made of heavy pressed steel.

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Opalax Has High Tensile Strength

A RECENTLY DEVELOPED GLASS, known as "Opalax" and manufactured by the Westinghouse Electric & Manufacturing Company, will supersede the light and dense alabaster glass in street-lighting units made by that company.

Street-lighting globes made from "Opalax" glass are of homogeneous construction. The departure from cased or multi-layer construction permits the manufacture of a globe which avoids the difficulties encountered in the attempt to produce two glasses of exactly equal expansion coefficients. "Opalax" itself is a strong glass of high tensile strength.

The degree of opacity chosen as the standard for "Opalax" is one which fulfills all the requirements of lighting service, it is claimed. The opacity is medium in degree. The glass is diffusing, but permits the effective use of refractors where these are deemed expedient.

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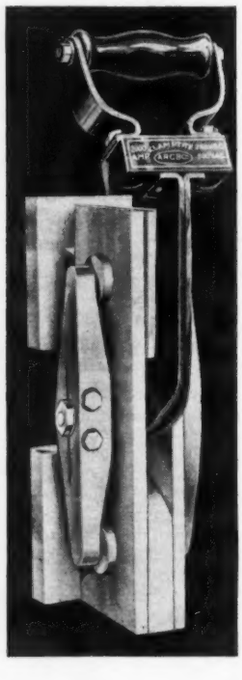
Knife Switch Has 600-Amp. Rating

A KNIFE SWITCH known as the "Klamp-Tite," and available in single, double or triple pole types in ratings from 600 amp. upward, has been announced by the Automatic Reclosing Circuit Breaker Company, Columbus, Ohio. The contacts of the new switch are first closed and then clamped, both with the same forward motion of the handle, thus making the contact joints equivalent to busbar joints.

A heavy manganese steel clamping



bar with distributing pressure foot at both top and bottom contact studs is attached to each outer switch blade by a clamping bolt with adjustable nuts fixed in the two clamping bars. The final action results in a heavy pressure being set up and transmitted equally to both top and bottom contact studs. This pressure is many times greater than that under which a knife switch could be manipulated ordinarily.

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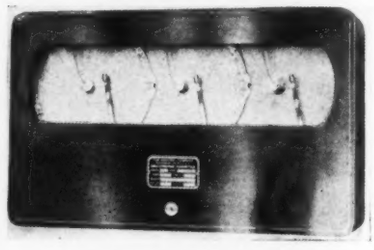
Triplex Ammeter for Unattended Stations

A TRIPLEX graphic ammeter designed for use in unattended substations is announced by the Bristol Company of Waterbury, Conn. It furnishes a continuous chart of currents in all three lines of polyphase feeders.

Recorders are obtained on three



Bristol standard 6-in. round charts, arranged in a horizontal line, but overlapping in such a way that while the active portion is in sight the whole width of the instrument permits its installation on an 8-in. panel.

In the design of the instrument the feature of unit construction has been kept in view, and it is possible to remove any of the measuring elements or the whole chart-driving mechanism as a unit without disturbing the adjustments of other parts of the instrument.

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Accurate Measurement of Motor-Starting Current

A NEW TYPE OF AMMETER which makes possible accurate measurement of the instantaneous starting current of a.c. and d.c. motors is announced by the Westinghouse Electric & Manufacturing Company. Such measurement has been accomplished in the past only with an oscillograph.

The new motor-starting ammeter is designated type PY-5. It can be used as an ordinary ammeter as well as to measure starting current. Such measurements as starting, locked-rotor and running currents are made without opening the circuit and without disconnecting the instrument from the line. The instrument has a double range, and changeover from one range to the other is accomplished simply by turning a switch on the side of the case.